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VOLUME 25 SEPTEMBER 21, 1936 NUMBER 19

The Evaluation of Textile Waterproofing Agents

*Part I. General and Theoretical**

ROBERT N. WENZEL†

WATER-repelling finishing are now applied to a wide variety of open textile fabrics and it is not difficult to predict that the future will witness a further extension of this field. Whatever other problems the textile finisher encounters in this connection, however, he is certainly not embarrassed by any scarcity of commercial waterproofing preparations. The advertising pages of our textile publications call attention to many such products, each of which is so far superior to all the rest that the finisher cannot possibly go wrong among them. Nevertheless he sometimes remains skeptical and insists on making his own comparisons. Moreover, it is no secret that the producers of these preparations are themselves not beyond trying an occasional modification which must then be evaluated against the performance of the established formula. Both producer and finisher have use then for test methods by which to compare the relative merits of waterproofing formulas and waterproofing methods; and it is this phase of the subject that it is desired to discuss in the present paper.

It must be recognized at the start, of course, that the requirements to be met by a waterproofing preparation embrace more than an evaluation of its waterproofing effect. For one thing, waterproofing preparations are sometimes used for objectives entirely apart from the water repellency of the finished fabric. The hosiery finisher requires a high degree of spot-proofing, to be sure, but he is interested no less in the improved appearance thus imparted to the finished stocking and its ability to remain presentable through all the handling it will normally receive on the shelves and counter of the retailer. Or he may regard the increased wear resistance of the proofed hose[1] as more important than its spotproof finish. Similarly, with piece goods the treatment may be applied primarily to reduce the shrinkage of the cloth during processing.

There are also considerations relating to the proofing preparation itself that demand attention. Most such preparations are marketed as concentrated aqueous emulsions. They should be fluid for ease of dilution and convenience in handling, and they must remain perfectly stable and ready for use during extended periods of storage. Finally, they are required to be compatible with other finishing agents encountered in the baths, free from excessive foaming or other undesirable behavior, and to have no deleterious effect on the dyes used or on the hand of the finished fabric. In many of these respects the only acceptable proof of satisfactory performance will lie in practical tests carried out under the operating conditions of each individual mill.

When we turn to the question of the waterproofing effect, there are two concepts involved that should be clearly distinguished. One is the water repellancy of the thread surfaces; the other is the waterproofness of the fabric. A minute's reflection will show that the two are not identical.

By the waterproofness of a fabric we mean the resistance it offers to the passage of water through it. Open fabrics can have no waterproofness unless the thread surfaces are made water repellent. This is the function of the proofing agent and the water repellency imparted to the surfaces is the direct measure of its merit. But when we measure the waterproofness of a fabric we are not measuring simply the surface effect of the proofing agent, because resistance to penetration by water depends also, to a considerable degree, upon other physical properties of the fabric, particularly the size of the largest openings. Thus the construction of the cloth, its uniformity, and the presence of any definite defects, as well as any modification of thread dimensions, tensile characteristics or lubricity, are all factors that can be expected to influence the size of the largest openings under the conditions of the test, and consequently to exert a direct effect on the waterproofness of the piece.

In the finished fabric, it may be that only the resulting waterproofness is of practical utility, but for comparing waterproofing agents, whether experimental or commer-

* Part of the material here presented is from a paper by the author in Industrial & Engineering Chemistry **28**, 988-994 (1936).

† Onyx Oil and Chemical Co. and Mellon Institute of Industrial Research.

cial, there is an obvious advantage in having also a method that evaluates the water repellency of the films they deposit, without being subject to uncertain factors introduced by fabric characteristics.

Before considering test procedures, it may be desirable to review briefly the fundamental principles underlying wetting action, to inquire into the nature of water repellency at solid surfaces and the way in which it operates to effect a waterproofness in open fabrics.

THEORY OF WATER REPELLENCY OF SOLID SURFACES

All analyses of wetting problems are based on the fundamental concept of specific surface energies. Every surface is the boundary (interface) between two homogeneous bodies (phases) of different chemical composition or physical state, and there is considered to be resident in every surface a quantity of energy per unit area, that is characteristic for that surface and completely determined by the properties of the adjacent phases.

The question of the origin of this energy need not concern us here; it is essential only to accept its existence, which is evidenced in many ways, its constancy for each particular interface under given conditions, and the further fact that any change in composition or properties of either phase will in general change the energy content of the interface.

When the surface of a solid is wetted by a liquid, an area of solid-air interface is replaced by an exactly equal area of solid-liquid interface. There is thus involved a change in surface energy. Now it is a universal natural law that those processes tend to take place spontaneously which involve a decrease in the energy of the system. Therefore, when wetting is accompanied by a decrease in surface energy, the wetted area tends to expand spontaneously, the energy difference being available to overcome resisting forces and the excess liberated as heat. Where wetting requires an increase in surface energy, the liquid will not wet the solid without receiving energy from some external source. The ease or difficulty of wetting a given solid with a given liquid is primarily determined, then, by the magnitude and direction (whether decrease or increase) of the energy change involved.

There are two general methods by which the energy change accompanying any process can be measured. One is to permit the process to proceed and measure the energy thereby converted into work, heat, or some other measurable form. Thus the relative wettability of solids can be studied by determining their heats of immersion, using a highly sensitive calorimeter. In order to obtain measurable temperature differences, however, since chemical action is sensibly zero, it is necessary to have very great surface areas. The solid must be very finely powdered. There is no satisfactory method then for measuring the exact total surface, which is an important factor in the calculations, and this limits the method, practically, to comparisons of different liquids wetting the same solid, where, by proper technic, the total surface can safely be assumed to be constant throughout a series of experiments. This method is not readily applicable to the present problem.

The second general method is to oppose the process by a measurable force just sufficient to prevent any action from taking place. Force methods are in general more convenient experimentally, and force relations are more easily visualized than energy relations.

It is customary, therefore, purely as a matter of convenience in dealing with surface phenomena, to replace specific surface energy values (dyne centimeters per square centimeter) by numerically equal surface forces (dynes per centimeter length). In other words, the characteristic energy content of 1 sq. cm. of the surface is represented by a force which, if allowed to act through a distance of 1 cm. would expend that much energy. These forces are termed surface "tensions."

The advance of a wetted area across the surface of a solid may thus be considered to take place in response to a force equal to the difference between the surface tension of the dry solid and that of the wet solid.* This force is called the "adhesion tension" and designated by the symbol A. Using the subscripts 1 to indicate the solid, 2 the liquid, and 12 (one two) the interface between them, the adhesion tension is defined by the equation

$$A = S_1 - S_{12}$$

where S_1 is the surface tension of the solid (solid-air interface) and S_{12} is that of the solid-liquid interface. The adhesion tension may be positive or negative, that is, it may act in the direction to induce wetting or to oppose wetting, depending upon whether S_1 is greater or less than S_{12}. It may be looked upon as the force, per cm. length, acting at the perimeter of the wetted area and causing it to expand or contract. For a given solid it measures the spreading tendency of the liquid; for a given liquid it expresses the wettability of the solid. It is this force that must be evaluated in order to compare the water repellency of different surfaces.

Unfortunately neither S_1 nor S_{12} can be directly measured. How then shall their difference, A, be evaluated? As suggested above, this can be done if the force A can be balanced by a measurable force just great enough to halt wetting action. Such a resisting force comes into play as an integral part of the wetting process itself. Its action is illustrated in the accompanying figures, 1-7.

When water spreads over a solid surface, there is also a change in the area of the liquid-air interface. Any increase in this interface is resisted by the surface tension, S_2, of the liquid. (Figure 1) While the adhesion tension, A, acts in the plane of the solid surface, S_2 can act only in the surface of the liquid and therefore at an angle, θ,

* It should be noted that, since every surface is an interface, every surface tension is also properly spoken of as an interfacial tension. The latter expression is now commonly used only for surface between condensed phases; i.e., solids or liquids, the term surface tension being reserved for surfaces in contact with a gas. The distinction, however, is entirely artificial and the two terms will here be used interchangeably.

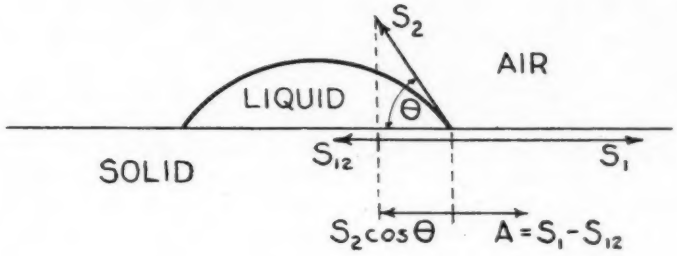
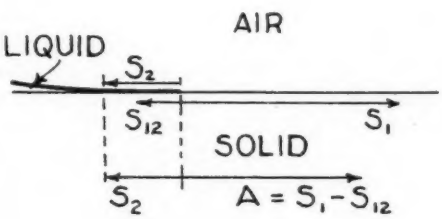


Figure 1.



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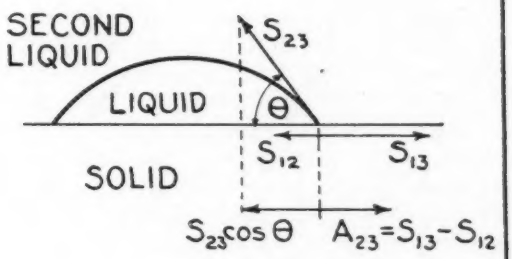

Figure 3.

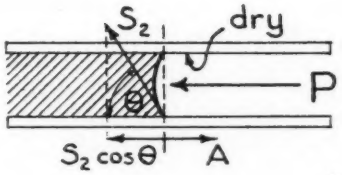

Figure 4. $A<S_2$

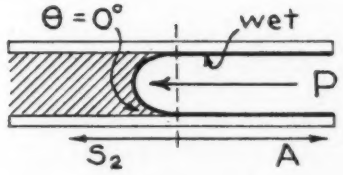

Figure 5. $A>S_2$

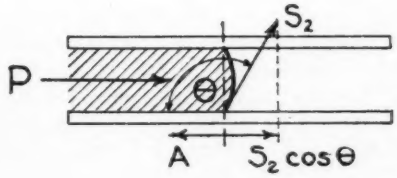

Figure 6. $A<S_2$

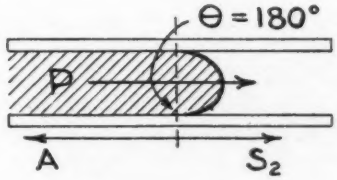

Figure 7. $A>S_2$

VECTOR RELATIONS OF SURFACE FORCES IN WETTING ACTION

with this plane, θ being the angle between the liquid and solid surfaces at their line of contact. Only the component of the force S_2 in the direction of the solid surface is thus effective in opposing the force A. This component is equal to the product of S_2 and cos θ, both of which can be measured experimentally.

If S_2 is greater than A, a value of θ will be reached at which the resisting force $S_2 \cos \theta$ becomes equal to A and prevents further spreading. (Figure 1) The value of $S_2 \cos \theta$ at this equilibrium position then measures A. If, on the other hand, A is greater than the whole of S_2 (Figure 2), the surface tension of the liquid will be unable to stop the process, even when acting in direct opposition to A; i.e., when $\theta = 0$, and spreading will continue until all the surface has been covered or all the liquid has been spread to its minimum possible film thickness. Obviously, in such cases some other means must be found for measuring the adhesion tension. It can be done in the following manner.

Instead of replacing air, the wetting liquid is made to replace another liquid, one which also wets the solid but less strongly, so that when alone on the surface of the solid it gives a definite, measurable contact angle. The value of A in the new case will then be the difference between its values for the two liquids separately:

$$A_2 \text{ (first liquid)} = S_1 - S_{12}$$
$$A_3 \text{ (second liquid)} = S_1 - S_{13}$$
$$A_{23} = S_{13} - S_{12} = A_2 - A_3$$

If this new value is less than S_{23}, the liquid-liquid interface tension, then spreading will stop at a definite contact angle exactly as in the case represented in Figure 1, the equilibrium condition (Figure 3) giving

$$A_{23} = S_{23} \cos \theta$$

Having determined both A_3 and A_{23}, the value of A_2 is given by their sum.

RELATION OF WATER REPELLENCY TO WATERPROOFNESS

In the penetration of water through a porous fabric, we have a situation closely analogous to that of the movement of water through capillary tubes, which is illustrated in Figures 4-7. Here spontaneous movement in response to adhesion tension at the wall of the tube is not resisted by the surface tension of the liquid, because no increase in liquid surface is necessarily involved. An external force applied to the body of the liquid (gravity for vertical tubes or air pressure for horizontal tubes) will be effective in halting spreading provided the force required is not greater than the liquid surface can transmit to the periphery, or in other words, not greater than the surface tension of the liquid. The situation is illustrated in Figures 4 and 5. If S_2 is greater than A, spreading will be stopped when the surface has been bowed to such a position that $S_2 \cos \theta = A$. (Figure 4) If A is greater than S_2, the maximum force that can be applied without expelling the liquid from the tube will reduce θ to zero and stop further progress of the liquid column, but it will not be sufficient to stop spreading. (Figure 5) To measure A in this case, it is necessary to resort to the use of a second liquid exactly as explained above. The force per unit length of periphery is calculated, in every case, from the applied pressure P, and the radius of the capillary.

All the above reasoning applies equally well, of course, to the case of negative wetting, or water repellency, where S_{12} is greater than S_1, A is negative, and θ is greater than 90°. Figures 6 and 7 illustrate this situation for capillary tubes. An applied pressure exerting a force equal to $S_2 \cos \theta$ per unit length of periphery will overcome the resistance to wetting when A is smaller than S_2. If A is greater than S_2, the applied pressure need only be sufficient to overcome the surface tension of the liquid to carry the liquid through the tube, no matter how great the value of A.

The relation between water repellency and waterproofness in textile fabrics corresponds to that between adhesion tension and penetration pressure in capillary tubes. It will be apparent from the foregoing discussion that the most that any waterproofing process can do toward preventing penetration of water through the openings of a fabric is to give the thread surfaces a water repellency (negative adhesion tension) as great as the surface tension of the wetting liquid. Any excess over this value is of no avail. Higher resistance can only be obtained by so increasing the amount deposited as to decrease the size of the openings. This interferes with the air porosity of the fabric and is generally undesirable.

THE MEASUREMENT OF WATER REPELLENCY

We have seen that the evaluation of water repellency requires the measurement of adhesion tensions; that force methods rather than energy methods are necessarily employed; and that force methods depend, in every case, upon the measurement of equilibrium contact angles. The measurement of water repellency resolves itself then into the measurement of contact angles.

Characteristics of Contact Angles

There are two important characteristics of contact angles that effect not only the choice of the method of measurement and the interpretation of the results, but also the behavior of solid substances generally in wetting or water repelling action.

First, there is apparently what corresponds to a frictional resistance to motion of the liquid-air interface across the surface of the solid. The contact angle is therefore somewhat different when the liquid is advancing than when it is receding. For this reason static contact angle measurements are unreliable. The liquid surface may come to rest at any angle between two extremes. To obtain reliable, reproducible values, the measurements must be made while the liquid surface is in slow, steady motion.

Secondly, and this is of importance in the application of proofing agents to fibrous surfaces, the contact angle

varies with the roughness of the surface against which it is measured. This is a factor that has not hitherto been clearly recognized, but it can be shown to be inherent in the generally accepted theory of wetting action.

When a drop of water ceases to spread, it is because at that point the wetting process no longer releases more energy at the surface of the solid being wetted than is consumed in further extending the free liquid, upper surface of the drop. The ratio between these two energy values continuously changes during the process because the ratio of the surface areas at the two interfaces changes. The energy change at each interface is the product, of course, of the specific energy of that interface and the amount of its area involved in the change. If the surface of the solid is rough, a given increase in the free liquid area at the top of the drop will be accompanied by the wetting of a greater actual area of solid surface under it, and the energy balance will therefore be reached at a different equilibrium point. The equilibrium contact angle will be different; the resistance to wetting will be different.

This point is illustrated in the diagrams of Figures 8 and 9. Referring to Figure 8, the left-hand sketch presents a plan view of the solid surface. The line *mn* is a segment of the periphery of the wetted area advancing from left to right. The solid surface is here considered to be ideally smooth, and consequently the energy content of a measured unit area, *abcd,* will be exactly the specific energy of the interface. Its values before and after wetting are represented by force vectors S_1 and S_{12} which are considered to act on the unit length *ab* of the periphery. Their vector sum, $S_1—S_{12}$, defines the adhesion tension, A, its negative value indicating its direction and marking it as a resistance to wetting.

The right-hand sketch of Figure 8 is the customary diagram of the equilibrium relation between the surface tension S_2 of the liquid, the contact angle θ, and the adhesion tension A, as given in the equation

$$A = S_2 \cos \theta.$$

It is important to notice that in this presentation the three forces, S_1, S_{12}, and S_2, must all be considered to act upon the same length of the intersection of the boundary surfaces, that is to say, between *a* and *b*.

Figure 9 represents the way in which the situation changes if the surface is roughened. The specific interfacial energy at the solid surface is concentrated within a smaller measured area, *efgh*. The solid-liquid and solid-air interfacial forces effective along the periphery from *a* to *b* are therefore magnified by the same factor, *r*, by which the surface contained within the area *abcd* has been increased. But the liquid-air interfacial force effective between *a* and *b* remains, as before, the surface tension S_2. It must, therefore, act at a greater angle, as shown, if it is to balance the increased resistance which the solid surface now opposes to the wetting process.

By an exactly similar analysis, if the solid has a positive wetting tendency, S_1 being greater than S_{12} and the equilibrium contact angle θ less than 90 degrees, the angle

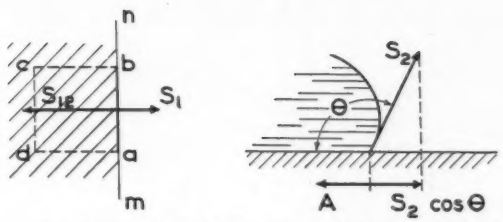

FIG. 8—Vector Relations of Surface Forces. Solid Surface Smooth.

θ', having again the greater cosine, will in this case be the smaller angle.

In either case the effect of a roughened surface is to magnify the wetting properties of the solid. A solid substance having a positive wetting tendency will wet the more readily, the rougher its surface. If the smooth surface is water repelling, the roughened surface will be more strongly so.

The roughness factor *r* can be defined as the ratio between the total or "actual" surface of an interface and what might be called its superficial or "geometric" surface, the latter being the surface as measured in the plane of the interface.

$$r = \text{roughness factor} = \frac{\text{actual surface}}{\text{geometric surface}}$$

It is apparent then that the second equation of the expression

$$A = S_1 - S_{12} = S_2 \cos \theta$$

can only apply where all surfaces are of perfect smoothness. For any real solid, the cosine of the equilibrium contact angle, multiplied by the surface tension of the liquid, measures not the adhesion tension A, but the product *r*A. We should therefore write

$$rA = r\,(S_1 - S_{12}) = S_2 \cos \theta$$

The factor *r* has the value 1.0 for solid surfaces of perfect smoothness.

Effective Adhesion Tension

The product *r*A may be termed the "effective adhesion tension": it is the value always measured experimentally. Unlike the adhesion tension, it does not have a fixed reproducible value dependent solely upon the chemical composition of the three contiguous phases. From the factor *r* it derives a disposition to vary widely and to be extremely difficult to control*.

Surface roughness accounts for the fact that many substances show excellent water-repelling properties on textile fibres when they are but slightly effective on smooth surfaces. It therefore widens the field of choice for textile proofing compounds. For the same reason, a distinct crystal habit in a wax-like material exerts a pronounced effect on its water-proofing action. Thus, if a wax of fair water repellency exhibits a contact angle of

* Note should be taken here of a point emphasized by Harkins[2]. In the actual experimental measurement of adhesion tension, the surface of the solid beyond the wetted area is not dry, but saturated with water vapor, or partly so. S_1 will therefore also have a variable, "effective" value. This is another reason why the adhesion tension, as measured, differs from its fixed theoretical value A.

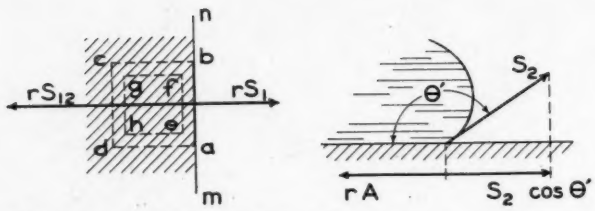

FIG. 9—Vector Relations of Surface Forces. Solid Surface Rough.

115° when the measurement is made on a perfectly smooth surface, a roughness factor of 2.0 resulting from a microcrystalline structure would increase the angle to 147° and greatly improve the effectiveness of this wax as a water repelling agent. The success of a spot-proofing treatment is determined, therefore, by the physical characteristics of the total deposit, as actually laid down on the fabric, quite as much as by its chemical composition.

The effect of the roughness factor will be apparent in the experimental results given in Part II below. Thus, in an extreme instance, aluminum stearate, deposited on a paper surface from a volatile solvent, gave an effective adhesion tension of —70.9 dynes per cm. compared with the value —28.6 obtained when a smooth surface of the same aluminum stearate was formed by hydraulic pressure between steel plates at 5,000 lbs. per sq. in. Assuming the latter surface to have been ideally smooth, the roughness factor of the paper surface was 2.48. From contact angle data published by Lee[3] for the spreading of asphalt on glass and stone surfaces under water, ground surfaces exhibited roughness factors of 2.24, 1.44, and 1.71 in three different cases[4].

In comparison with these figures, let us consider for a minute what range of values of r is to be expected. If a smooth surface is corrugated, with inclined planes at 45° form the horizontal, it is obviously given a roughness factor of $\sqrt{2}$, or 1.41. Notice that this figure is independent of the size of the corrugations. They might be reduced in size to microscopic or submicroscopic. The value of r would remain 1.41. The same is true of each of the following values for surfaces made up as indicated:

	r
Hemispheres,	$2\pi r^2/\pi r^2$ or $\frac{r}{2.00}$
Square pyramids (slant height = side of base),	2.00
Equilateral tetrahedra,	3.00
Adjacent smooth cylindrical threads,	$\pi/2$ or 1.57
Yarns of smooth cylindrical threads,	$(\pi/2)^2$ or 2.46
Yarns of threads of smooth cylindrical filaments	$(\pi/2)^3$ or 3.87

Real fabrics might be expected to have still greater ratios of actual to geometric surface, but the value would be reduced by the presence of finishing agents at the surface. Possibly the increased waterproofness often obtained upon ironing or hot calendering a proofed fabric is to be explained by the melting in of the surface coating, revealing again the more minute irregularities of the thread surfaces.

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*Part II. Measurement of Contact Angles**

A NUMBER of different technics have been devised for the measurement of contact angles. They may be divided into three classes: (1) the direct measurement of the contact angle in degrees, (2) its calculation from measurements of the dimensions of drops resting on the surface, and (3) its calculation from measurements of pressures of displacement in capillary tubes or pores.

Direct measurement of the angle at which the surface of a drop meets that of a solid on which it rests involves several experimental difficulties. Whether the drop be photographed or its shadow projected against a protractor scale, there is always the difficulty of determining the exact position of the tangent to a curve at the point where the curve stops. Also, unless evaporation can be avoided, the angle will change progressively during measurement, because of the friction effect already noted. This can be avoided by making the observation on bubbles of air under the surface, immersed in water, but the uncertainty of static readings can only be eliminated by slowly augmenting the drop or bubble through an aperature in the solid surface. There is also the objection to these methods that they measure the angle at only a single point on the periphery of the drop whereas, unless the surface of the solid is ideally smooth, the angle with the horizontal may vary widely from point to point. Sharp changes in the curvature of the profile just before the liquid surface meets the solid are thus as frequently encountered as not.

Calculation of the angle from the dimensions of the drop gives an integrated value free from this objection. Moreover, Guilford L. Mack[1] has shown that when the drops are so small that their shapes closely approximate spherical segments, the angle obtained agrees well with the maximum or advancing contact angle measured dynamically. The obvious disadvantage here is that

* Largely reprinted from Ind. Eng. Chem. **28**, 988-994 (1936).

the test applies to such a minute area of the surface under examination.

Pressure of displacement methods are most satisfactory for many test purposes, but for the rapid comparison of the surfaces of different types of solids they present an insurmountable difficulty in the construction and calibration of the capillary tubes or porous plugs.

The method finally adopted for the study of water-repelling surfaces in this laboratory was the direct measurement of contact angles by the tilting plate procedure. This method is rapid, gives a dynamic reading of the contact angle integrated across the area under test, is readily applied to a wide variety of surfaces, and affords results reproducible with a considerable degree of accuracy anywhere within the entire range of practically significant values.

TILTING PLATE METHOD

The tilting-plate method of measuring contact angles was apparently first described by A. K. Huntington,[2] who used it to measure contact angles against cleavage surfaces of blende and galena in studying the flotation of sulfide minerals. In different forms it has since been employed by a number of investigators ([3, 4, 5, 6, 7, 8]).

The principle of the method may be stated very briefly. If a flat plate is dipped into a liquid, the surface of the liquid as it approaches the plate will curve upward or downward to establish the angle of contact required by the several interfacial surface tensions. If the liquid is water and the plate is coated with a water-repellent substance, the contact angle will be greater than 90° and, when the plate is vertical, the water surface will curve downward on either side of the plate. As the plate is tilted, the curvatures will change to maintain the contact angle, the curvature of the water surface on the under side of the plate becoming less and less and finally disappearing altogether. At this point, where the water surface is flat and horizontal right up to the line of contact with the plate, the angle to which the plate is tilted measures the contact angle. If the plate is tilted beyond this position, the water surface on the under side of the plate takes the opposite curvature, rising as it meets the plate.

The apparatus developed for the present use is shown in the accompanying photograph (Figure 10). About half the length of a microscope slide, cut to ½ inch in width, is coated with the solid to be tested. The liquid is held in a cell with ends and bottom of brass, the front and back sides consisting of microscope slides joined in place with balsam cement. The cell is supported on a mechanical stage that permits it to be moved horizontally or raised and lowered smoothly and steadily.

A petrographic microscope is used in horizontal position, the cell being independently supported between the microscope tube and the revolving circular stage. The slide is clamped to the revolving stage in such position that the coated end dips into the water in the cell and its plane surfaces are parallel to the line of sight. The edge of the plate is thus presented to the observer. By revolving the microscope stage, the plate is rotated about the line of sight as a center. Its angular position at any time can be read from the circular scale and vernier on the microscope stage. The plate holder is provided with a screw adjustment for centering the slide in the field.

It has been found satisfactory to use the microscope without either objective or eyepiece. Viewed in this manner, the appearance of the meniscus and the way it changes as the plate is rotated are shown in Figure 11. With proper illumination, a fine bright line appears near the bottom of the meniscus that is quite sensitive to changes in the position of the plate. By adjusting the forward edge of the plate to within one millimeter of the cell wall, the water surface at that point is thrown upward and out of the way so as not to interfere with observation of the meniscus beyond.

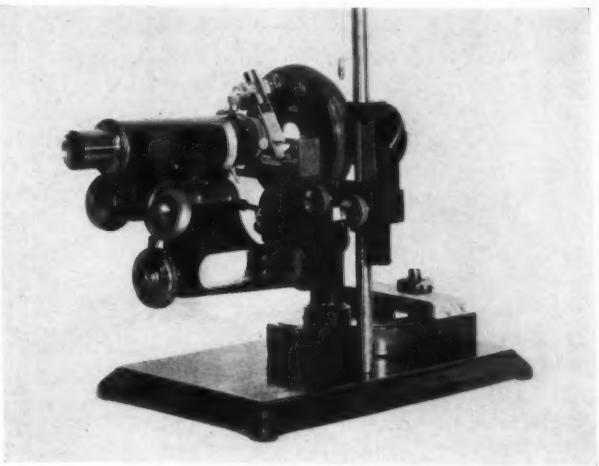

FIG. 10—Tilting Plate Apparatus for Contact Angle Measurements.

FIG. 11—Change of Curvature of Water Surfaces with Rotation of Plate.

The plates may be coated by dipping into the melted sample at a suitably elevated temperature or by any other convenient means. In cases where the solid will not adhere to glass, or the coating loosens and peals off when submerged in water, brass strips of similar dimensions have been used. If necessary, several small holes can be drilled through the metal near the bottom edge and others well above the water level so that the coatings on the opposite faces of the plate will be tied together by the coating material itself and thus securely anchored to the plate. If sufficiently rigid, a plate itself molded of the material to be tested can be used. Tests on emulsions, to be applied from dilute baths, have been made possible by using half-inch strips cut from sheets fabricated by bonding heavy steel-plate paper of pure rag stock to

both sides of a 28-gage steel sheet by means of a metallic adhesive*. These sheets can be dipped, run through squeeze rolls and ironed dry, exactly as a textile fabric would be, but, being rigid, can be used for the contact angle measurements. Finally, if desired, measurements can be made directly on strips of proofed textile fabric backed by a waterproof adhesive tape and mounted on metal plates.

Exact levelling of the apparatus is made unnecessary by taking two successive readings, the plate tilting in the one case to the left, in the other to the right. Half the difference then gives the angle from the vertical and this value plus 90° gives the contact angle. Usually the operation is repeated a number of times for each determination.

For concordant results, all settings must be made while the cell is being very slowly raised. This procedure is essential because of the frictional resistance already noted. In the study of waterproofing, we are interested in the total force resisting wetting; and as this frictional force, if it may be called such, acts to assist the effective adhesion tension in opposing wetting, it is the maximum contact angle that becomes the important criterion.

As the water level is raised, minute surface irregularities on the plate may cause the very tip of the water line to vibrate or advance with an irregular motion. The individual threads of a mounted piece of fabric have the same effect. This action does not confuse the end-point, however, because the main curvature of the water surface is an integrated effect apparent for a centimeter or more away from the plate.

For experimental work on finishes, this method has indeed a distinct advantage over hydrostatic pressure tests on proofed pieces of standard fabric, because the numerical result obtained is not descriptive of only the few least resistant openings of the thousands included in the area under test. When using fibrous materials on the plate, however, the submerged area becomes wet through, more or less rapidly, and while several measurements can usually be made at a single immersion, the readings cannot then be checked over the same area without drying. With the bonded metal-paper sheets, strips five or six inches long can be employed and tested at either end; also, the wet portions can be cut away with metal shears to obtain further check readings.

The method gives results accurate to within a few degrees. It can be used to measure angles up to and slightly beyond 170°, but it is difficult to take readings that close to the horizontal. Bearing in mind that the water repellency is proportional not to the contact angle but to its cosine, and further that 180° corresponds to the maximum useful value of the effective adhesion tension for waterproofing purposes, the exact values of readings beyond 170° have very little significance.

EXPERIMENTAL RESULTS

Table I gives data obtained with ordinary crystalline

* The bonded metal sheets used were supplied through the courtesy of Dr. A. W. Coffman, of Mellon Institute.

TABLE I

Contact Angle Measurements, Paraffin Wax

Date (1934)	Plate No.	Temp. (°C.)	Readings (deg.) Left	Right	Diff. D	$\theta = (D/2+90)$	$rA = 72 \cos \theta$ (dynes/cm.)
June 1	1	—	159.3	202.3	43.0	111.5	
			159.0	204.3	45.3	112.6	
			156.9	203.6	46.7	113.3	
			156.3	203.6	47.3	113.7	
					Average	112.8	—27.9
June 2	1	19	155.7	201.4	45.7	112.8	
			156.5	202.7	46.2	113.1	
			156.4	201.4	45.0	112.5	
			155.5	201.6	46.1	113.0	
					Average	112.8	—27.9
June 4	1	30	154.5	199.9	45.4	112.7	
			154.3	201.8	47.5	113.5	
			154.6	201.3	46.7	113.4	
			153.7	199.9	46.1	113.1	
					Average	113.2	—28.4
June 4	2	30	159.5	197.7	38.2	109.1	
			159.5	199.5	40.0	110.0	
			159.6	197.6	38.0	109.0	
			158.0	198.4	40.4	110.1	
					Average	109.5	—24.0
June 4	3	30.5	157.3	198.9	41.6	110.8	
			159.0	197.0	38.0	109.0	
			156.3	197.4	41.1	110.6	
			157.7	198.0	40.3	110.2	
					Average	110.2	—24.9

TABLE II

Contact Angle Measurements, Waxes and Wax-like Products

	Temp. (°C.)	Contact Angle (degrees) Plate 1	Plate 2	Aver.	Effective Adhesion Tension (dynes/cm.)
Paraffin wax, amorphous	31	108.7	111.8	110.2	—24.9
Ozokerite, yellow	29	110.1	109.9	110.0	—24.6
Ozokerite, bleached	29	113.3	113.0	113.2	—28.4
Beeswax	30	106.8	108.3	107.6	—21.8
Carnauba wax, crude	28	123.7	122.0	122.8	—39.0
Carnauba wax, refined	27	124.8	125.8	125.3	—41.6
Candelilla wax	29	110.2	112.8	111.5	—26.4
Spermaceti	26	111.9	108.4	110.2	—24.9
Japan wax	27	102.7	103.1	102.9	—16.1
Montan wax, crude	..	140.0	139.6	139.8	—55.0
Commercial synthetic wax A	25	112.1	112.3	112.2	—27.2
Commercial synthetic wax B	28	103.1	101.6	102.4	—15.5
Commercial synthetic wax C	26	107.2	107.6	107.4	—21.5
Commercial synthetic wax D	..	119.1	121.1	120.1	—36.1
Commercial synthetic wax E	..	101.5	105.4	103.4	—16.7
Commercial synthetic wax F	..	120.4	118.2	119.3	—25.2
Commercial synthetic wax G	..	108.0	108.6	108.3	—22.1
Commercial synthetic wax H	28	131.4	131.4	131.4	—47.6
Commercial synthetic wax I	26	124.4	122.6	123.5	—39.7
Commercial synthetic wax J	28	129.9	130.8	130.4	—46.7
Commercial synthetic wax K	25	107.7	106.8	107.2	—21.3
Commercial synthetic wax L	26	123.6	124.2	123.9	—40.2
Commercial synthetic wax M	28	108.0	107.6	107.8	—22.0
Commercial synthetic wax N	26	107.9	105.8	106.8	—20.8
Commercial synthetic wax O	26	112.5	112.6	112.6	—27.7
Commercial synthetic wax P	27	118.4	118.5	118.4	—34.2
Commercial synthetic wax Q	25	120.4	120.9	120.6	—36.7

TABLE III

Contact Angle Measurements, Miscellaneous Materials

	Solvent	Contact Angle (deg.) Plate 1	Plate 2	Aver.	Effective Adhesion Tension (dynes/cm.)
Cellulose acetate	(molded strips)	64.0	64.8	64.4	31.1
Cellulose acetate	acetone	63.8	63.7	63.8	31.8
Raw rubber	benzene	59.5	55.5	57.5	38.7
Synthetic resin	(coated paper)	86.2			4.8
Gum tragacanth	hot water	109.7	106.1	107.9	—22.1
Gum arabic	hot water	97.4	100.1	98.8	—11.0
Gum copal	ethyl alcohol	103.6	106.0	104.8	—18.4
Gum guaiac	ethyl alcohol	64.3	67.4	65.8	—29.5
Gum kauri	isobutyl alcohol	87.0	79.1	83.3	8.4
Gum elemi	isobutyl alcohol	63.4	66.9	65.2	30.2
Gum damar	carbon tetrachloride	58.2	62.8	60.5	35.4
Rosin	ethyl alcohol	64.4	69.1	66.8	28.4
Ester gum	isobutyl alcohol	63.9	64.8	64.4	31.1
Stearyl alcohol	none	49.2	51.0	50.1	46.2
Stearone	none	134.4	131.9	133.1	—49.2
Monohydroxystearone	none	119.4	119.0	119.2	—35.1
Dihydroxystearone	none	113.8	113.6	113.7	—28.9
Erucone	none	115.4	114.8	115.1	—30.5
Stearone 90, rosin 10	none	106.2	106.2	106.2	—20.1
Stearone 90, paraffin 10	none	124.6	122.0	123.3	—39.5
Stearone 90, synthetic wax 10	none	145.8	144.3	145.0	—59.0
Stearone 90, mixed ketones 10	none	138.7	141.5	140.1	—55.2
Stearone 50, shellac wax 50	none	155.4	154.8	155.1	—65.3

TABLE IV

Metallic Soaps on Paper Surface, from Chlorasol Solution

	Concentration of Solution (gms./liter)	*Contact Angle (deg.)*	*Number of Readings Averaged*	*Average Deviation (deg.)*
Aluminum palmitate	25	154.8	14	1.1
Aluminum stearate	25	157.6	6	3.9
Magnesium stearate	5.6	140.6	6	0.9
Aluminum palmitate	2.5	148.8	6	1.8

TABLE V

Metallic Soaps on Paper Surface, from Carbon Tetrachloride Solution Effect of Ironing

	Concentration of Solution (gms./liter)	*Contact Angle (degrees) Initial Value*	*After Ironing*
Magnesium stearate	4.8	128.4	164.3
Calcium stearate	7.5	113.6	128.3
Barium stearate	2.4	118.9	150.2
Thorium stearate	4.0	108.4	147.4

TABLE VI

Metallic Soaps on Paper Surface, from Hot Isobutyl Alcohol Solution

	Contact Angle (degrees)			*Effective Adhesion Tension (dynes/cm.)*
	Plate 1	*Plate 2*	*Average*	
Magnesium stearate	145.9	140.6	143.2	—57.6
Tin stearate	151.6	149.1	150.4	—62.6
Barium stearate	152.5	157.2	154.8	—65.2
Thorium stearate	158.8	159.4	159.1	—67.2
Cadmium stearate	162.0	165.2	163.6	—69.1
Zinc stearate	162.9	170.1	166.5	—70.0
Aluminum stearate	169.4	170.8	170.1	—70.9

paraffin wax and illustrates the degree of consistency in the contact angle readings. The plates were of glass or metal and were coated by dipping. It will be noted that readings taken at different times on the same plate are likely to be in better agreement than readings on duplicate plates. The results also show that a considerable variation in room temperature had no great effect on the readings.

Table II presents the average readings on each of duplicate plates of other waxes and wax-like products. In a few cases initial transient readings were obtained, higher than the constant values later arrived at. Thus Japan wax gave initial readings of 107° to 111°, which dropped to relatively constant values at 103° and to still lower values around 99.5° after soaking the slides for fifteen minutes in water. Carnauba wax gave initial transient values around 130° and constant values at 125°. In the case of the wax listed as commercial synthetic wax K, which gave initial transient readings at 115° and final values at 107°, the change was due to solution of the sample or some constituent thereof in the water, inasmuch as the same plate again gave high initial readings on changing the water in the cell.

Measurements recorded on gums and certain other materials are summarized in Table III. As indicated, some of these materials were deposited from solvents.

The most varied results were obtained with metallic soaps. This fact will be apparent on inspection of Tables IV, V, and VI, which give the results found on metal-bonded paper surfaces.

In the experiments of Table IV, test cards, 10 in. x 2½ in., were treated on squeeze rolls with solutions of the metallic soaps in chlorasol; i.e., a mixture of three parts of ethylene dichloride and one part of carbon tetrachloride. These cards were then air-dried overnight, cut into strips and tested at a number of different points. The number of areas tested and the extent of variation of the readings are indicated. The two more dilute solutions were applied five times with intermediate air-drying.

Using carbon tetrachloride as the solvent, the initial values obtained were lower but were increased in every case by pressing under a hot iron. The data are shown in Table V. Results for calcium stearate are here, comparatively, very poor. In a similar test, using a solution containing 5.2 grams per liter in chlorasol, calcium stearate gave final values of 147.1° and 147.9°. Tin stearate prepared from stannous chloride and sodium stearate, the latter made from a commercial triple-pressed distilled stearic acid, was found sufficiently soluble in boiling isobutyl alcohol for coating onto glass plates. This coating gave initial values below 120° after air-drying overnight, but the values increased after contact with water, check readings near the end of the plate being higher than readings taken at points where the surface had not been previously immersed. Values approximating 140° were thus obtained. Light ironing, without sufficient heat to impair the coating, which had a tendency to flake off on cooling, raised the contact angle beyond 150° in every case, giving values of 151.5°, 152.4°, and 159.0° on three different plates. The increase in this case can only be accounted for by a change in the crystal form of the deposit.

The results of Table VI were obtained by dipping the paper-surfaced plates into solutions in hot isobutyl alcohol and drying in a desiccator overnight before testing. Subsequent pressing with a hot iron gave no improvement in these results.

Of particular interest are a number of different values obtained for aluminum stearate. Deposited from solution on paper surfaces, it afforded results shown in Tables IV and VI, varying rather widely. Similarly deposited on glass, it gave values nearly as high, averaging 150.3°, 159.4°, and 151.2° on three plates. But when molded into half-inch strips by hydraulic pressure at 5,000 lbs. per sq. in., it gave consistent readings averaging only 113.4° where the plate was smooth, waxy and transparent, and 119.2° where it was white, chalky and opaque.

Most of the waxes gave the same values on glass whether deposited from a solvent or from the melted wax, but there were a few notable exceptions. All gave much higher values on paper surfaces than on glass. Some examples are presented in Table VII. Residual traces of non-aqueous solvents were eliminated as a cause of this behavior by the fact that it was also observed with ether after long aeration and with absolute alcohol. Those waxes that gave higher values on glass, when deposited from a solvent, reverted to the lower values if the plates were placed in an oven for a few minutes to fuse the coating. There was no appreciable alteration in the appearance of the deposit.

The advantages and limitations of contact angle meas-

TABLE VII

Contact Angle Measurements (Deg.) Waxes
Effect of Method of Preparing Plates

	From Melted Sample			
	Originally Reported	*Same Plate Re-tested After Six Months*	*From CCl_4 Sol. On Glass*	*On Paper*
Beeswax	108	113.6	125.0	155.2
Paraffin	110	110.5	110.7	152.4
Spermaceti	110	113.8	....	149.6
Carnauba wax	125	129.2	127.3	153.1
Synthetic wax A	112	116.6	164.9	158.0
Synthetic wax H	131	129.8	131.6	150.4
Synthetic wax P	118	123.8	136.2	149.2

TABLE VIII

Contact Angle Measurements on Proofed Fabrics

	Contact Angle (deg.)		*Hydrostatic Press. ($Cm.H_2O$)*	
Fabric:	Silk	Rayon	Silk	Rayon
Openings per sq. cm.:	2,700	1,600	2,700	1,600
Aqueous emulsion	167.8	169.0	17.5	9.5
Non-aqueous solution	169.3	....	7.4	....

urements are well illustrated by the comparison, given in Table VIII, of contact angle and hydrostatic pressure test results obtained on two different fabrics proofed by identically the same treatment and on the same fabric proofed by different treatments. The contact angle measurements show that the two fabrics, after being treated with the same aqueous waterproofing emulsion, have equally repellent thread surfaces. This result is not shown by the hydrostatic pressure method because of the difference in the construction of the fabrics. The second preparation applied to the same silk fabric is a non-aqueous solution of waxes capable of proofing the thread surfaces equally well, but it is seen to impart much less resistance to the passage of water under pressure. This difference is to be explained by effects on thread dimensions and air porosity.

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Notes on

Dyeing and Finishing Cotton Fabric

For Corsets, Belts and Brassieres

KELLS O'GORMAN

COTTON fabric still remains supreme as the material *par excellence* for conversion into the standard type of corsets, sports belts and brassieres suitable for hard wear. Of late years rayon has been used wholly or partly in the manufacture of corsets of the "dressy" kind, in which appearance is perhaps of more estimation in the eyes of the consumer than the wearing quality. Most discriminating corset purchasers are agreed that a cotton garment stands the strain of every day wear better than corsets constructed wholly or partially of rayon without rubber reinforcement at vital points. We find, therefore, that the better qualities of cotton fabric are still favored for corsets, etc., of the made-to-measure type in which cost is not the first consideration to the potential wearer.

Before taking up the consideration of dyeing and finishing processes for corsets, belts and brassiere fabrics it will be expedient to explain why so many plants which have attempted to enter the corset cloth processing line have failed to gain a permanent footing in this exclusive sphere of operations. Apart from errors in the construction of the fabric with which the present article is not concerned, the principal cause of failure of those concerns who have tried to enter the business of corset cloth finishing has been the faulty processing leading to ultimate tearing and collapse of the fabric under the terrific strain suffered by this class of material during wear when the corsets are tightly laced. Probably no feminine garment suffers such an amount of severe usage as the corset and sports belt, for the fabric is subjected to acute tension, stresses and relax all the time the garment made from it is being worn. Few garments, moreover, have to suffer so much from perspiration as has the corset and sports belt and as this is usually allowed to dry on the fiber, since the garments are so seldom laundered, it is not to be wondered at if the fabric becomes thoroughly rotten in an uncommonly short space of time. Operations like bleaching and dyeing have therefore to be controlled most carefully, in order to avoid tendering the cloth, for once even the slightest tendering begins, the trouble will quickly become worse after conversion of the fabric.

The customary bleaching process undergone by cotton corset fabrics is as follows: After the stock has been singed, the pieces are desized and then left piled for some hours to soften. The next operation is to lime-boil in an horizontal kier of the open-width type. A light sour with hydrochloric acid is then given after which the stock is thoroughly washed in clean water. The next

(Continued on page 524)

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Standard Wash Fastness Samples

Cotton, Wool, Silk

The standard samples which have been in preparation for some time by the Sub-Committees on Fastness to Washing of Dyed Cotton and Dyed wool are now ready for distribution, and the original standard silk sample cards have been revised to correspond with the new system of classification first introduced in the 1934 Year Book.

These standards have all been carefully dyed with the dyestuffs and according to the dyeing methods recommended in the 1934 Year Book and each set includes a dyeing representing each of the different classes of fastness.

With these sample dyeings for reference it will be possible to accurately grade the fastness to washing of any dyed cotton, wool, or silk fabrics, by comparing them with the standards after subjection to the standard washing tests as approved by the Association.

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Comparison of the

Light-Fastness Types for Dyed Textiles

*As at Present Employed**

PROF. DR. P. KRAIS†

THE Fastness Commission and Committees in Germany[1], England[2], and the United States[3] have all published standard types for the determination of the light-fastness of dyeings. In my province as chairman of the committee on work to be recommended, of the German Fastness-Commission, with which the Textile Expert group of the Society of German Chemists is associated, it has been for several years my aim to bring about a unification of methods, types, etc., wherever possible. The standards in manufacture and use, however, in these countries are too different to justify one in hoping for such a unification for all standards of fastness, although such a unification might be desirable, from the standpoint of the dye manufacturer, as well as the dyer. At all events, it seemed possible to attain to a certain uniformity at least in the field of light-fastness, after necessary correspondence with the foreign committees had informed us as to their wishes. Their desire centered first of all in the dyeing of the standard types upon a single textile material, preferably wool, these types to serve as standards for dyeings upon all classes of fiber. Another point proposed was, that all types should consist of one color only.

The German Fastness-Commission adopted this view, by acceptance of the eight blue standard types of light-fastness dyed on wool, proposed by the I. G. Farben-Industrie A.-G. The I. G. has published a very full paper (Mell. Textilber. *3*, 539 (1932), describing the very laborious development of these standard types[4].

In the three series of standards, we are dealing with the following dyeings, in which the numbers given in parentheses after the names of the dyestuffs refer to the listing of the dyestuffs in the seventh edition of G. Schultz, Farbstoff-Tabellen, Leipzig 1931.

GERMAN TYPES

I—0.6% Brilliant Wool Blue FFR extra.

II—0.6% Wool Blue N extra (825).

III—1.0% Brilliant Indocyanine 6B.

IV—1.5% Wool Fast Blue GL (974).

V—1.0% Cyananthrol RX[5].

VI—2.5% Alizarine Direct Blue AGG.

VII—2.5% Indigosol AZG (1332) decatized.

VIII—3.0% Indigosol Blue AGG, decatized.

ENGLISH TYPES

Red

I—[6]

II—0.5% Acid Magenta IIS (I.C.I.) (524).

III—0.5% Polar Red 3B conc. (Geigy).

IV—1.0% Cloth Fast Red R (Ciba).

V—1.0% Alizarine Rubinol GW (I. G.).

VI—1.0% Kiton Fast Red 4BL (Ciba).

VII—1.2% Alizarine Orange A 425 powder dyed on zinc mordant (I. C. I.) (779).

VIII—1.75% Durindone Red B 400 powder (I. C. I.) (912).

Dr. Krais's valuable report has been read with much interest by the Light Committee of the A.A.T.C.C. With regard to his suggestion that the irregular fading of the American standards when tested in Dresden sunlight, as compared with the results obtained by us in Washington, may be due to the greater intensity of sunlight in the latter city, we are inclined to agree with him. This theory is supported by his statement that the A.A.T.C.C. standards, when exposed to the much more powerful Custers lamp, behaved quite normally.

It should also be remembered that in Germany, as Dr. Krais explained, samples are exposed until only a "perceptible difference" is noticed between the exposed and unexposed surfaces. In our light tests, on the contrary, samples are exposed for several different periods of time, each period being twice a long as the preceding one, and the fastness of each dyeing is estimated from a study of all the faded areas rather than only one. This method has been preferred by us because some dyes fade more rapidly at the start and more slowly thereafter, while the reverse is true with other dyes.

Since Dr. Krais's report was published, several changes have been made in the German standards, and the revised list has been officially accepted by all the large dye firms in Germany and Switzerland and by a committee of the Society of Dyers and Colourists in England. Our Association has been requested to adopt these new standards in preference to our own, and tests are under way which will determine our action.

Wm. H. Cady,
Chairman, Sub-Committee on Light Fastness, A.A.T.C.C.

* Translated from Angewandte. Chemie *49*, 55 (1936).
† Dresden

Blue

I—

II—0.5% Lissamine Violet 6 BNS (I. C. I.) (548).

III—0.6% Brilliant Indocyanine 6B (I. G.).

IV—1.1% Polar Blue G conc. (Geigy).

V—0.5% Solway Blue RS (I. C. I.) (859).

VI—2.0% Alizarine Light Blue 4GL (Sandoz).

VII—4.0% Caledon Blue GCP 300 powder (I. C. I.) (842).

VIII—3.0% Indigosol Blue AGG (Durand and Huguenin).

AMERICAN TYPES

I—2.0% Indigotine conc. (DuPont) (877).

II—1.2% Scarlet 2R conc. (Gen. Dyestuff) (82).

III—2.0% Amaranth extra conc. (Geigy) (881).

IV—1.8% Sorbine Red X (Gen. Dyestuff).

V—2.5% Diamine Fast Red FC (Gen. Dyestuff).

VI—6.0% Indigosol O (Carbic) (874).

All the English and American standards, like the German, are dyed upon wool. The American types I, II, III, IV, and V correspond almost exactly to the older wool-types I, II, III, IV, and VI of the German Fastness-Commission, as they are given in the fifth edition of the Bulletin (Bericht) of 1931.

The task which I proposed to myself was that of subjecting these types to a comparative light-exposure test measured in "Fading-hours" by means of the blue-paper "measuring-stick" proposed by me several years ago[7]. This method of determining light-fastness has often been employed by my fellow-workers, and has given good results in such cases as involve a comparative character, or when it is a case of repeating fading tests for the same number of hours, at different times of the year. The standard employed is not an absolute, but a local one, mine, therefore, is adjusted to the sunlight of Dresden. The exposures in this study were carried out behind glass, with the swatches inclined at an angle of 45°, according to the requirements of the Fastness Commission, although by exact adjustment of the glazed case at right angles to the direction of the sun's rays, an increased fading action was attained. The exposures were prolonged "until a visible alteration of the swatch under test was recognizable," as it is expressed in the sixth edition of the Fastness Commission's report. This alteration was considered as having taken place when, at the boundary between exposed and unexposed surface, a perceptible difference was to be noticed.

This work was combined with an examination of the action of the new light-fastness testing instrument (it might be called a fadeometer, if not so infringing upon the rightful title of another well-known instrument for the same purpose—Translator), which Dr. J. F. H. Custers[8] has constructed in the Research Laboratory of the N. V. Philips Gloeilampenfabrieken in Eindhoven, Holland. I had an opportunity to convince myself of the good features of the apparatus, of its uniform fading action from the first to the last hour of the lamp's glowing, and of the fact that the cooling of the swatch, exposed to an irradiation of about eighteen times the strength of sunlight, actually does hinder its overheating, when the irradiation is not too long continued. More later on regarding this.

In the following table 1 may be given the "fading-hours," which I have determined with the different types, carrying the exposure to the perceptible visible alteration mentioned above.

TABLE 1

Hours of Sunlight After Which a Perceptible Alteration of the Dyeings Was Manifest

Standard	*German*	*English*		*American*
		Red	*Blue*	
I	1	—	—	6.0
II	3.5	3.5	3.5	41.5
III	6.0	6.0	6.0	50.0
IV	18.5	18.5	18.5	57.0
V	41.5	41.5	41.5	107.0
VI	50.0	69.5	69.5	180.0
VII	100.0	95.0	100.0	
VIII	138.5	132.0	138.5	

It is clear, from these figures, (1) that the English red and blue standards run nearly parallel, (2) that the German types I to V, VII, and VIII correspond to the English ones, which I consider as a specially gratifying result, for, taking all things into consideration, it is less important that all standards be dyed with the same dyestuff, than that they correspond in their light-fastness, (3) that only the German type VI falls out of line, being not so fast as the English type, and does not stand so nearly half-way between V and VII as the English type. I do not wish to express any final decision, dependent upon that single test, but intend to look further into the matter through repeated tests. It appears worth while to notice that the English type is dyed with Alizarine Light Blue 4GL, that is, a specially lightfast acid dyestuff, while the German type is dyed with Alizarine Direct Blue AGG, for which, however, the light-fastness of VII is claimed in the Wool-Circular of the I. G. for 1932.

And (4) one is also justified in stating that the (English and German) standards are arranged approximately in the sequence of 1—3.5—6—20—40—70—100—140 fading hours, which should correspond completely to the demands of practical work; (5) that, on the other hand, the American standards are of quite another sort, and in my opinion not so well chosen; there is a large gap between I and II, then hardly any difference between II, III, and IV, there is another gap between IV and V, while with type VI, a

deep blue-black, I have not been able to detect a distinct alteration at all, in the 180 fading hours during which I have continued the tests. It is not beyond supposition that there is involved, in this case, a threshold-value, which is overcome by the American, and not by the Dresden sunlight.

—In regard to the fading of dyeings by irradiation of a different intensity, the chairman of the American committee, W. D. Appel[9], has published a paper, according to which, for example, the time of exposure required to produce a given amount of fading at intensity 0.1 may be anywhere from 10 times to only 2 times that required at intensity 1, according to the nature of the dyestuff employed. One might consider quite the same situation as possible in the case of intensities which are greater than normal sunlight; and in this way, perhaps, the lack of uniformity which I have found in German type VI, exposing it only to full sunlight, might be cleared up.

I now come to the experiments with the new lamp of J. F. H. Custers, who kindly exposed my blue test-paper, and also the standard types of the three committees, in his apparatus. The work proved that his lamp, according to the blue-paper standard, has 18 times the strength of Dresden sunlight. The measurements of the types, as far as could be determined, gave the following figures (minutes of exposure required to produce a perceptible alteration), opposite which I have placed other figures 18 times their value, that is, the equivalent of the Custers figures in my "fading hours."

TABLE 2

Results with the New Lamp of Custers

	German		*English*				*American*	
			Red Types		*Blue Types*			
Type	*Mins.*	*Fading Hrs.*	*Mins.*	*Fading Hrs.*	*Mins.*	*Fading Hrs.*	*Mins.*	*Fading Hrs.*
I	3	1	—	—	6	1.5	60	18
II	12	3.5	6	1.5	18	5.5	120	36
III	18	5.5	18	5.5	120	36	180	54
IV	60	18	45	13.3	180	54	240	72
V	180	54	180	54	180	54	480	144
VI	300	90	270	81	300	—		
VII			60	18!				

If one compares these figures with those of Table 1, he will find that the German types I—IV correspond well in the two tables. For the rapid testing of dyeings up to 1 "Custers hour" or 18 "fading hours," the new lamp is therefore very suitable for use. But from that point on the results do not agree. The reason for this is that with the German types V and VI, a fading (in the proper sense) of the dyeing does not take place as it does in sunlight, but the color becomes brown, which apparently protects the dyestuff from further decomposition. Quite similar phenomena occur with the blue English standards, while in the reds type VII drops entirely out of sequence; here, too, the alteration consists of a darkening in tone. The American types appear to be well arranged in steps, better than with solar irradiation; but here, too, they are relatively much faster than our own and the English types.

A circumstance which, of itself, makes more difficult the already very exacting work in this field is, that more than one dyeing, which shows a distinct alteration after exposure, renews itself, so to speak, after some time, so that one can hardly recognize any alteration at that subsequent time. This appears to take place particularly in the reds (e.g., with the English red types V—VII), so that blue types are to be preferred for this reason. In any case, however, this circumstance must be kept more in mind for the future. I shall pay special attention to it in my further examination of German type VI.

References

[1]"Verfahren, Normen und Typen fuer die Pruefung der Echtheitseigenschaften von Faerbungen," Verlag Chemie, G.m.b.H., Berlin W. 35, 6th Edition, 1932. (The 7th edition is in preparation.)

[2]Report of the Society of Dyers and Colourists on the Work of Its Fastness Committee. Published by the Society, 30-32 Piccadilly, Bradford, 1934.

[3]1933 Year Book of the American Association of Textile Chemists and Colorists, p. 116.

[4]Melliand's Textilber. *3*, 539 (1932).

[5]In the 6th edition of the "Verfahren, etc." 1.3 per cent is specified, but this has recently been changed, in order to improve the spacing of the steps.

[6]A type 1 was not prepared, as being too fugitive.

[7]Angew. Chemie *24*, 1129, 1302, 1809 (1911).

[8]Chem. Fabrik *8*, 103 (1935).

[9]Am. Dyestuff Reporter *24*, 306 (1935).

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Members of this association, who are without employment, should forward to the secretary a statement as to their qualifications and experience. This information will subsequently appear on these pages with an identifying key number. Employers are also requested to file with the secretary or the American Dyestuff Reporter any vacancies which may occur in their businesses.—H. C. Chapin, Secretary, Lowell Textile Institute, Lowell, Mass.

Key: A—Laboratory and research; B—Dyeing or printing; C—Finishing; D—Sales; E—Instruction; F—Executive.

NOTE: PERSONS WHO HAVE OBTAINED EMPLOYMENT SHOULD NOTIFY THE SECRETARY OR THE AMERICAN DYESTUFF REPORTER AT ONCE. Prospective employers may file vacancies either with the secretary or the American Dyestuff Reporter.

A-6

Education—Analytical Chemistry and Dyeing Course, Lowell Textile Evening School.

Experience—Seven years as print color and dye chemist in printing, dyeing and finishing plants; recently in charge of textile printing department of dyestuff manufacturer.

A-B-2

Education—Lowell Evening Textile School. 1917.

Experience—Five years' experience in hosiery dyeing, full fashioned hosiery of silk and cotton and silk, also men's hosiery containing rayon, wool, cotton and celanese. Several years experience in laboratory work. Has also had experience in jig-dyeing of cotton piece goods, slub and top dyeing.

A-B-4

Education—B.T.C. 1934, Lowell Textile Institute.

Experience—Assistant chemist in cotton knitting plant; second-hand in woolen knit goods dye house. Will go anywhere; references.

A-B-5

Education—Graduate of the University of Lausanne, Switzerland. Doctor's degree in Chemistry. Knowledge of French and German.

Experience—Eleven years with large bleaching, dyeing, printing and finishing plant as assistant Chemist and then Chemist in charge of the Laboratory. Experience in dyeing and printing cotton and rayon fabrics; research and analytical work. Woman.

A-B-7

Education—Evening school in textile dyeing.

Experience—2 years laboratory in dyehouse; 9 years dyer and foreman on hosiery, ribbons and rayon; 2 years assistant to superintendent. Can handle help efficiently. Desires position as supervisor or demonstrator of dyestuffs. Age 30; married. Prefers vicinity of New York.

A-B-C-2

Education—Graduate of Lewis Institute of Engineering of Chicago and graduate of Philadelphia Textile School (Chemistry and Dyeing department).

Experience—Has had extensive experience as assistant chemist and colorist in silk printing, dyeing and finishing; also dyeing raw stock wool; and dyeing and finishing cotton and rayon. Age 30; married; references.

A-B-C-3

Education—3 years at Brown University and Drexel Institute.

Experience—2½ years in dyestuff laboratory; 3 years as second-hand, dyeing indanthrene and direct colors on rayon skeins; 6 months as boss dyer on silk and cotton ribbons and hosiery; 3 years overseer of dyeing and finishing rayon tubing. Can handle laboratory, dyehouse, finishing or outside service. Age 30; married.

A-B-C-D-E-1

Education—B.S. Chemistry, Mass. Institute of Technology.

Experience—Plant and laboratory work. Knowledge of wool scouring; cotton, worsted, celanese and rayon slashing; bleaching, dyeing, printing and finishing of cotton cloth; printing of Plissé; manufacture of soaps, finishing compounds and wetting-out agents; analytical work; solution of mill manufacturing difficulties; dyestuffs and their application to wool, cotton, rayon; textile teaching experience; paper mill work; some sales experience; references; married; 43 years old.

A-B-C-F-1

Education — Five years chemistry and engineering, Brown University (Evenings).

Experience—1 year general superintendent at print works (shirtings, dress goods, etc.; cotton and rayon). 12 years chief chemist and superintendent of large bleachery and dyeworks (cotton, rayon and silk piece goods). 4 years chemist in charge of control work in bleach, print and dye works (cotton, wool and rayon piece goods). 9 years chief chemist and assistant superintendent in gas and oil manufacture. Practical dyer and finisher and can handle help efficiently and get results. Can help a plant seeking to improve their vat dyeing, shrinkage results, finishes and service to customers. Age 45; married.

A-C-1

Education—4 years at Newark Evening Technical School in Chemical Engineering.

Experience—8 years in manufacturing, research, testing of soaps, oils, gums and finishes and application of same in all phases of the textile industry. Age 23, single. References.

A-E-1

Education—Ph.D., Univ. of Illinois, studied chemical engineering at Columbia, licensed chemical engineer, New Jersey.

Experience—10 years' experience teaching in colleges, subjects included chemical and textile subjects. Has had broad experience in industrial work including experience in testing materials, research and consulting. Will go anywhere; references.

B-1

Education—Educated and trained in chemistry and calico printing in Glasgow, Scotland.

Experience—Has been with large print works as colorist for 13 years producing first class work on cotton, rayon, wool and silk fabrics. References.

B-2

Experience—Boss dyer with one firm for 18 years, divisional supt. at print works for 1 year, in charge of processing and dyeing of cottons and rayons at large bleachery for 6 years. Prefers bleachery in East but will go anywhere. References.

B-3

Experience—Foreman piece dyer for the past 21 years. Can dye the following: celanese, rayon, cotton backs, wool, silk and mixed fabrics. Has knowledge of finishing and laboratory work.

B-6

Education—Graduate R. I. School of Design.

Experience—5 years in bleachery, 7½ years as assistant dyer, 2 years as boss dyer and 3 years as superintendent of dyeing and finishing. Married, 33 years old. References.

B-7

Experience—Eight years as boss dyer on skeins and ribbons. Over ten years as chemist and head dyer for a large hosiery mill. Experienced on Silk, cotton, rayon and wool in skeins, ribbons, piece goods and all kinds of mixtures. Willing to go anywhere. Not afraid to work or face responsibility. Can handle help efficiently.

B-8

Education—Chemistry and Dyeing Department, Philadelphia Textile School.

Experience—Eleven years experience as chemist and boss dyer on the following: woolen, worsted and cotton yarn; woolen, worsted and union piece dyes on both ladies' and men's wear; wool, cotton, shoddy and mohair raw stock. Age 33, married, will go anywhere. References.

B-9

Experience—Hosiery dyer with fifteen years' experience on high grade silk hosiery; familiar with all types of machines. Age 43, married. Will go anywhere.

B-14

Education—Rhode Island School of Design.

Experience—Familiar with all classes of wool dyeing. Seven years with large carpet mill as dyer and processor of washed oriental rugs. Will go anywhere, married, 37 years old. References.

B-17

Education—Lowell Textile Institute (Chemistry and Dyeing Course) 1916; extension courses at Brown University.

Experience—6 months dyeing wool at finishing company; 2½ years research work on bleaching, dyeing and finishing at dye works; inspector of textile equipment, U. S. Ordnance Dept., during war; 15 years as superintendent of dyeing at finishing company, including all types of colors on cotton piece goods and some rayon and celanese; handled chemical work at last named plant for many years as well as dyeing. Age 40, married, prefers East. References.

B-20

Education—Chemistry and Dyeing Dept., Philadelphia Textile School.

Experience—Thirteen years' experience as boss dyer on the following: rayon and cotton skein and piece goods and knitted fabrics. Raw stock dyeing in pressure dyeing machines. Age 35 years, married, can handle help efficiently.

CALENDAR OF COMING EVENTS
Meeting, New York Section, Swiss Chalet, N. J., October 23, 1936.

annual meeting and convention

• TENTATIVE PROGRAM

Friday A.M. — Registration and Sight-Seeing

Friday P.M. — 1:30 Council Meeting
2:30 Research Committee Meeting
Sight-Seeing
6:30 Buffet Supper
7:30 Technical Papers
9:30 Smoker

Saturday A.M. — 9:30 Technical Papers
12:00 Election of Officers
Annual Business Meeting

Saturday P.M. — 2:00 Technical Papers
7:30 Banquet
Speakers
Entertainment

providence, r. i. december 4 and 5

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AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS

AMERICAN
DYESTUFF
REPORTER

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COST OF LABOR LEADERSHIP

THE doctrine of the divine right of kings was bad enough, but not so intolerable as the present-day belief that the rights and interests of labor can be protected only by labor agitators.

To anyone who will take the pains to look about him, it must be clear that labor leaders are making no progress in safeguarding these rights and interests, whatever they conceive them to be. Still debating the questions as to whether the time is ripe for a country-wide campaign to unionize all workers, and by whom and in what manner the task shall be accomplished, labor union officials have finally brought a wide-open break in the ranks of organized labor.

No doubt the heated battle in which Messrs. Green and Lewis are involved must be somewhat irritating to the three million or so dues-paying unionists, who have supposed all along that their leaders had the correct answers to their problems, and were mapping in perfect accord a campaign in their common defense.

As things stand, President Lewis of the United Mine Workers, desires a militant union conquest to begin at once in all industries. President Green of the American Federation of Labor wishes to proceed more slowly over the established road of unionization by crafts.

The fact that both groups have been, and still are, bitterly opposed to those organizations of employees, which are formed independently and successfully in separate companies, has not been sufficient to prevent the suspension of the Lewis group (one million strong) from the Federation.

Without wishing to throw stones on anybody's porch, it might be pointed out again that from Society's standpoint these futile attempts at unionizing, these repeated quarrels to get reorganized, and this periodic fighting against the so-called "company unions," are very costly.

Losses already sustained by these activities cannot, of course, be stated with any degree of accuracy, but it is well known that the figures are enormous. To fight the steel companies on the question of industrial unionization, the Lewis group alone has $500,000 to spend, to say nothing of what the corporations themselves can, or will, lay out in the defense of their own policies.

One cannot help wondering if such expenditures, after all, really result in better wages, hours and working conditions for labor, and if the battles between the agitators, and their campaigns for members do not arise out of a desire to profit themselves.

Surely, it is no great secret that four million members of unions, paying on an average of $25 annually in dues, contribute some $1,000,000,000 to the treasuries of their leaders each year. And, to appreciate that the stakes in the present conflict are extraordinarily large, one has only to calculate what the annual income from dues would be if an additional 30 or 35 million workers were similarly organized.

Some politicians, also, have a stake in the fortunes of labor. To win the elections in 1934, their war-cry for labor was a five-day week. Now the hue and cry is against company unions.

Having become skillful in their respective trades, laborers ought to do their own thinking, weighing the costs of collective bargaining through labor unions against the real, and not the supposed, benefits attainable therefrom.

If the advantages were very great, the American Federation of Labor, which claims to represent American labor, would have enrolled by 1936 more than 1/10th of the employed population of the United States, and would not now be threatened with disintegration.—*Clarence W. Fackler, Associate Professor of Economics, New York University.*

CORRECTION

The article which appeared on page 479 of the September 7th issue was incorrectly titled. Instead of reading "Why Direct Dyes Color Cellulose Acetate" it should have read "Why Direct Dyes Color Cellulose Fibers."

ANNUAL MEETING
A.A.T.C.C.
Providence, R. I.
December 4 and 5

Notes on

Dyeing and Finishing Cotton Fabric

For Corsets, Belts and Brassieres

(Continued from page 514)

operation is to chemick the stock, a solution of ¼ to ½° Twaddle being employed. The pieces are then piled for some hours with the chemick still in them in order to allow the chemick time to exert its full bleaching power. The next operation comprises the white sour, a solution of hydrochloric acid, 2° Twaddle being employed here. The goods are piled after impregnation, a period of about 2 hours being allowed in the pile, then a final wash in a square beater apparatus is given the pieces, after which they are dried.

Nowadays the majority of shades in demand on corset fabric are pale ones like peach, ecru, shell pink, etc.; heavy shades like dark grey, drab slate, and black which were once in popular demand on corset fabric are no longer in such request now that garments of the washable type with detachable rustless steel boning are being manufactured. Before this type of corset was introduced it was an extremely rare procedure to launder a pair of corsets since boning was of the non-detachable type, which, after taking out of the washtub rusted in the paper sheaths which encased each bone. It was customary therefore for corset wearers to demand dark, sombre colors on the garments they chose, since perspiration stains and other soiling did not show up conspicuously on such a background. Black and other sombre shades are still in demand however for fabrics wanted for conversion into strong, non-washable corsets of an inexpensive type.

Since most of the shades in present demand on corset fabrics are pale ones, dyeing is frequently carried out in a padding machine, particularly with the thinner cloths. Stout contil, nankeen and jean stock has to be processed in the dye jig since penetration is defective if such goods are colored in the padding machine. Substantive colors of good fastness to washing and perspiration are widely employed for dyeing corset fabrics. Vat dyestuffs are used only for goods of the very highest quality. Inexpensive substantive colors are used for processing the cheaper grades of cotton corset stock and in some instances little consideration is given as to whether the dyestuff used will withstand perspiration and laundering or not. Such stock is frequently processed in the padding machine with the adidtion of a penetrant.

The following substantive dyes are, among others, of use for ordinary requirements on corset stock: Benzo Blue R W (C.I. 512); Direct Deep Black E W Ex (C.I. 581); Direct Deep Black R W Ex (C.I. 582); Mikado Orange (C.I. 621); Benzamine Brown 3 G O (C.I. 596); Chrysophenine (C.I. 365); Diamine Green G (C.I. 594); Toluylene Orange G (C.I. 478); Benzo Orange S and Benzo Fast Scarlets (C.I. 326); Diamine Green B (C.I. 593); Diamine Brown M (C.I. 420); Diamine Sky Blue F F (C.I. 518); etc.

The following are typical padding recipes for some of the substantive colors enumerated above.

(1) Cream:
- 2 oz. Chrysophenine (C.I. 365)
- 1/16 oz. Diamine Brown M (C.I. 420)
- 1 pint penetrant
- 40 gallons water

(2) Buff-pink:
- 1 oz. Benzo Fast Scarlet (C.I. 326)
- 2 oz. Chrysophenine (C.I. 365)
- 1 pint penetrant
- 40 gallons water

(3) Sky:
- 2 oz. Diamine Sky Blue F F (C.I. 518)
- 1 pint penetrant
- 40 gallons water

Dry finishing is the next process to be considered. If a well closed cloth is wanted, as is sometimes the case where the stock is for conversion into high class garments of the washable type, beetling for six to eight hours will be necessary. Such garments are expected by many of the purchasers to be capable of withstanding several launderings without depreciation in the body of the fabric; hence the employment of "filling substances" on this class of material is not usually contemplated. A limited amount of corset fabric is converted into garments while in the bleached condition. This class of material seems only to be in demand by consumers in tropical countries. If it is desired to use a filling on such stock, a useful mixture for the purpose is as follows:

- 56 lbs. maize starch
- 1½ gallons proprietary glaze
- 5 lbs. China clay
- ¾ pint glycerine
- 100 gallons water
- tinting blue as required.

A two bowl mangle is employed when applying the above filling to the stock.

A highly glazed finish is not usually required on corset fabric; in solitary instances where such an effect is wanted, wheat, or some other type of starch is used as the basis of the filler, borax or wax being put in the mixing in order to increase the luster of the processed cloth. Only wax with a low melting point is suitable for the purpose in question and it must be used just as the starch begins to thicken up during cooking. It is customary to melt the wax in a little boiling water before adding it to

the mixing kettle. A soft finish is not always desirable for corset fabric since garments made from such stock handle "limply" during examination by the consumer. Most purchasers of hard-wearing corsets of an inexpensive type look for a firm handle in the fabric panels of the garment and it is frequently necessary to "fill" the cloth with suitable stiffness in order to develop the finish demanded. The following is a suitable recipe for this purpose:

35 lbs. maize starch
12 lbs. white dextrine
1 gallon glaze
½ pint turkey red oil
bulked to 65 gallons with water.

In some instances the corset manufacturer specifies lustrous material with a medium soft handle. Back-skimming with a suitable mixing may suffice in meeting this requirement in some cases; in others the goods are filled on a two-bowl mangle with the following mixing:

25 lbs. maize starch
4 lbs. white dextrine
1 gallon glaze
½ pint turkey red oil
bulked with water to 80 gallons.

Another useful mixing for corset fabric comprises:

35 lbs. farina
5 oz. borax
bulked to 100 gallons with water.

If it is desired to develop a semi-lustrous finish, the stock is dried, damped and stretched after filling and then friction calendered once or twice on the face side of the fabric.

A boardy finish is sometimes wanted on black-dyed corset fabric for conversion into the strongest class of inexpensive garment for the use of females who take vigorous exercise or who require an article capable of standing up to the strain of domestic and mill work. The following mixing is suitable for this purpose.

65 lbs. yellow dextrine
3 oz. soda ash
3 oz. Direct Deep Black E W Ex (C.I. 581)
bulked to 80 gallons with water.

The dyestuff should be dissolved in hot water and the solution is then sieved before adding to the mixing.

Dyeing with Basic Dyes*

Qualities of New Mordants—Preventing "Bronzy" Selvedges—Sodium Sulfide as a Stripping Agent

"FOREMAN DYER"

OUR experience is that basic dyes are not used so much as they once were. Possibly this is because basic dyes are not of good fastness either to light or washing (most fastness tables list these dyes as of the lowest fastness degree 1) and the public has now been educated up to the stage of requiring better fastness than that with which they were at one time quite well satisfied, and possibly it is because other and faster types of dyes now include colors nearly as bright as basic dyes. But in our own particular works basic dyes have become less important for quite another reason.

Before and shortly after the great war we dyed thousands and thousands of pieces of cotton fabric in bright dazzling blue, green, yellow, and red shades which could only be obtained by using such basic dyes as Victoria Blue, Brilliant Green, Rhodamines B and 6G, and Auramine. Much of this fabric was given a schreiner finish so that it had the utmost luster. All this fabric was shipped abroad to China and India. Now that we have lost much of this Eastern trade we have not had to dye such bright shades, for this type of colored fabric is much too gaudy for the home market. Whether it will ever come back remains to be seen, but we much doubt it.

METHODS OF MORDANTING

In those days the cotton was first mordanted with tannic acid and antimony salts. This was practically the universal procedure for the more recent sulfurized phenol mordanting products now sold under such names as Katanol (I. G.) were not then known. The mordanting process involved two separate treatments, first with tannic acid and then with antimony salts, and was something of a nuisance to the dyer. Before Katanol appeared (this had the great advantage of being applicable in one bath and being quite as good a mordant for basic dyes as antimony tannate) we were on the lookout for a simpler method of mordanting. It occurred to us that since direct cotton dyes had an affinity for basic dyes so that in many instances the two types of dyes precipitated each other when their solutions were mixed, a possible line of investigation would be that of preparing a colorless direct cotton dye. With this in mind, we attempted the preparation of various azo compounds by coupling diazo-

* Reprinted from Canadian Textile Journal.

tized amines with tannic acid. Unfortunately all the compounds made in this manner were yellow to brown in color and this made them unsuitable as mordants.

QUALITIES OF "KATANOL" MORDANTS

In the middle of this research Katanol was introduced by I. G. and when it was disclosed that this mordant was a colorless sulfur dye we recognized that this dye-making firm had definitely chosen a line of research more likely to yield success than we had. We abandoned our search for an antimony tannate substitute but the work carried out was not altogether wasted since it proved useful in a subsequent research. It is perhaps useful to note that a deep brown pigment was discovered by coupling diazotized paranitraniline with tannic acid. Also, future research might yet reveal a mordant along the lines which we then followed.

One of the advantages of Katanol and similar products over antimony tannate as a mordant for basic dyes is that it does not harshen the fabric. Neither does Katanol reduce the luster of the fabric. It was always observed on mordanting a mercerized cotton fabric with tannic acid and antimony salts that it became duller and lost much of its softness.

PREVENTING "BRONZY" SELVEDGES

Dyeing bright blue shades with Victoria Blue was always difficult since when this process was carried out in a jigger the selvedges acquired a deep bronzy color; actually the depth of color on the selvedge was about twice that on the middle of the fabric. Other dyers experienced the same difficulty and it was generally assumed that the bronziness was caused by oxidation of the dye by reason of its exposure to air on the selvedges. We ourselves had reason to doubt this explanation but nevertheless it seemed reasonable.

It is a fact of experience that in washing cotton piece goods in a jigger it is most difficult to wash the selvedges so thoroughly as the remainder of the fabric. The selvedges are more tightly woven and thus they retain tenaciously any substances, soluble or insoluble, with which they have been impregnated. With this in mind, we argued that if the cotton fabric be treated with a solution of a substance having a reducing action and then lightly washed before dyeing with Victoria Blue, the selvedges would retain some of this substance and thus oxidation of the basic dye would not take place so readily in dyeing. It seemed likely that this method would enable bronzy selvedges to be avoided. We tried out this theory using glucose as the reducing substance, but no success was obtained; the selvedges were just as bronzy as in ordinary dyeing. Perhaps the glucose under these conditions did not exert its full reducing action, but whatever might be the case, we henceforth doubted whether the oxidation theory of bronzy edges fully explained all that it was intended to.

Today, bronzy selvedges can be prevented by adding Peregal P (I.G.) to the dyebath since this liquid has a remarkable power of dispersing basic dyes. Perhaps it also has a reducing action.

SODIUM SULFIDE AS A STRIPPING AGENT

The usual method for stripping basic dyes from fabric faultily dyed is that of first treating it with a warm dilute solution of caustic soda to remove or destroy the mordant, and then removing the dye by treatment with hot acetic or formic acid. When this method proved only partly effective recourse was made to the use of bleaching powder. It was in connection with a difficulty of this kind that we discovered an alternative method which subsequently proved very useful on numerous occasions, especially when Brilliant Green crystals was used in the dyeing.

The removal of a basic dye from the fabric is obviously facilitated by first removing the mordant. We therefore tried the use of a hot solution of sodium sulfide. This substance simultaneously stripped the mordant and reduced the dye to a colorless decomposition product. In this manner and with certain basic dyes, stripping could be carried out in one operation. Possibly sodium hydrosulfite could be used instead of sodium sulfide, but this did not occur to us at that time.

OIL AND ALUMINUM SULFATE MORDANT

On one occasion we were requested to dye some red shades which appeared to be brighter than any colors we had hitherto produced by means of Rhodamines on an antimony tannate mordant. After enquiry and experiment it was found that this exceptional brightness of shade could be obtained by using a mordant of Turkey red oil and aluminum sulfate instead of the tannate mordant. The cotton fabric was first given several ends in a hot solution of alum and then quickly run through a cold solution of Turkey red oil; the oil and alum formed an insoluble soap in the fabric and this had the property of fixing basic dyes and causing them to have exceptional brightness of shade. In some cases we found it better to dry the alum-impregnated fabric before treatment with the Turkey red oil solution.

The shades obtained with Rhodamine B and 6G on such an oil mordant were absolutely dazzling and they proved satisfactory for the purpose for which the fabric was intended. Nevertheless we found that the fastness to light of such shades was as poor as they were brilliant. If a piece of the dyed fabric was left lying about in sunlight for but a few minutes whilst awaiting finishing, patchiness was produced as a result of fading. This fabric was shipped to the East, and we often wondered what opinion the Chinese formed of our dyeing. Subsequently we learnt that in the East, basic dyeings faded to a much less extent than they do in Europe and that this difference is connected with the humidity of the climate.

Basic dyes are especially interesting from many points of view and it will perhaps be possible to return to them at a later date.

TECHNICAL NOTES FROM FOREIGN SOURCES

Chemical and Molecular Structure of Textile Fibers

Dr. P. Krais—Monats. f. Textil-Ber. 49,205 (1934).—The present paper is a summary of the recent work and the most recent results of study of the topic, based upon papers by Staudinger and by Astbury and Woods.

Staudinger's review covers over 130 separate publications by different authors, and is based upon the Harworth formula for cellulose, that which regards cellulose as glucose laterally condensed. He concludes, from measurements of viscosity, that cellulose possesses a degree of polymerization of 750. So many glucose residues are therefore linked in with one another into cotton cellulose; and form long, rod-like molecules of 4,000 Angstrom units in length, the length being to the diameter in a ratio of 500/1. The cellulose molecule in viscose is much shorter; in ramie it is much longer, the latter form having as its degree of polymerization 1,000. This appears plausible enough, since the cellulose formed in the interior of the ramie stalk is certainly exposed to fewer disturbing factors than is the case with the fibers growing on the surface of the cottonseed within the capsule of the cotton plant. It will be of interest to ascertain the results from hemp and flax. Naturally, the above figures are not to be taken as of absolute value, but as average results between certain definite limits.

With this conception of cellulose as a long, threadlike molecule, the whole field of study is comprehensible at a glance; and the micellular theory established by other authors, and the views offering a much lower molecular weight, may be considered as collapsed. Staudinger has supported his views by exhaustive studies, with the help of his assistants, along analogical lines, especially through his measurements of viscosity of various synthetic polymerization products. The view of E. Schmidt and his co-workers, that natural cellulose contains carboxyl groups, is briefly but conclusively proved erroneous by M. Luedtke. —Staudinger has also overthrown the micellular theory as to caoutchouc, in K.'s opinion. His work indicates that the caoutchouc of highest molecular weight possesses a degree of polymerization of 1840 isoprene molecules. Caoutchouc is much more easily broken down than is cellulose ("verkrackbar"—we are glad to note that an undoubted master of his subject and of his language, as Prof. Krais, is not afraid to produce a new word when he needs it; and such men have the right to do so); through comparatively mild purification its degree of polymerization falls to 1300, and through mastication to 300. It is obvious of how much importance a knowledge of this fact should prove to the rubber industry. K. is interested in the fact particularly because of its analogy to the case of cellulose; but also in view of the fact that recently latex itself is being spun in the precipitating bath to very fine fibers, which are already being utilized in the industry for various textile goods, and is therefore becoming the basis of a new branch of the industry.

What we are to understand by the cracking of the molecule (the term is used as employed in the petroleum industry) and how the valences set free become disposed of, makes further study desirable.

Mercerized cotton, that is, the so-called hydrated cellulose, formed by addition of caustic soda and its subsequent splitting off,—a substance corresponding in its chemical structure to the cellulose of viscose and cupro-silks, but not correspondent in its molecular length, has been studied carefully by C. Schubert at the suggestion of W. Schramek.

Astbury and Woods have published work upon wool. Astbury has already published a good book of general nature upon his studies with the Roentgen ray. Since he is himself a mineralogist and physicist, rather than a textile worker, he bases his conceptions principally upon the work of Speakman and his co-workers, as far as his chemical labors are concerned. In his paper here noted, he closes with a comprehensive summary of 21 points, of which K. mentions several, viz.; he distinguishes between alpha-keratin, which in its natural, unstretched form composes the wool fiber, and beta-keratin, which is present in stretched wool-fiber, and differs from the alpha form in chemical nature. He mentions the three phases of stretching (slow, rapid, slow), and the three forms or kinds of keratin, K_1 (intercellular), K_2 (cell-wall), and K_3 (cell-content), of which the whole fiber consists. In the case of silk he assumes that the fiber consists of only one chief molecular chain, which is built up of alternating alanine and glycine residues, and that four parallel groups form a crystallagraphic group. It is true that the grounds for this view have already been published by R. Brill. The following points may be noted as especially significant:

1—The Roentgen spectrograph of beta-keratin is similar to that of natural silk in the stretched or unstretched condition. Therefore, beta-keratin is formed of stretched polypeptide chains, while alpha-keratin must consist of the same chains in a folded condition.

2—Alpha-keratin can be stretched reversibly by about 2 per cent before its transition to the beta-form begins.

3—The highest stretch of the hair of mammals amounts to about 100 of the original length.

4—The side-chains of beta-keratin have the purpose of binding together the chief chains through numerous cross-unions, so that covalent as well as electrovalent unions come into consideration.

5—The structure of beta-keratin corresponds to that of flat polypeptide network-groupings, which form through condensation of carbonyl groups with imide groups.

6—Available chemical analyses of keratin stand in accord with the assumption of an amino-acid residue, of the

average dimensions of 3.84 × 4.65 × 9.8 Angstrom units, as is shown from Roentgenographs of beta-keratin, in which figures the first denotes the length of a residue, the second the thickness of a sidechain, and the third the average width in the plane of the sidechains.

7—An approximate scheme of the division of the sidechains is provisionally proposed, in which cystin residues, salt unions, and inactive sidechains alternate.

8—The elastic properties of the hairs possibly stand in some connection with the three types of keratin (see above), which show increasing resistant properties, as well as a possible relation to the stretching-power, rather than a relationship to resistance toward chemical attack.

9—Roentgenographs show in a distinct way that absorbed water enters not only between the groups of chains, but also into their interior, and that, during the hydrolytic alteration of the beta-keratin through steam or alkalies in dilute solution, spatial alterations take place along the direction of the sidechains.

10—These spatial alterations are the intramolecular foundation of the loss in stretching power, which takes place when the hair is kept under tension in water, and denotes the beginning of a series of alterations which culminate in the phenomena of transient and permanent fixation.

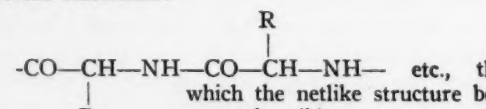
11—This fixation originates in the new state of division of the sidechain unions, and probably for the most part, but not exclusively, of those of the electrovalent (salt-like) unions.

12—As an intermediate stage between the breaking off of the sidechains, and their reattachment in a different form, there exists a labile condition of increased contractile power, which can exert itself up to 45 per cent below the normal, unstretched length of the hair (supercontraction), and can be explained quantitatively upon the basis of the closest approximation of the acid and the basic sidechains.

13—The sidechains are of a fourfold character:—

1—a—basic—arginin, lysin, histidin,
b—acid—glutamic acid, asparagic acid,
2—hydroxylic—serin, prolin, tyrosin,
3—inactive—amino-acids, tryptophan, glycin, alanin, valin, leucin,
4—cystin.

14—The chief chain is formed of a regular successive series of CO,NH, and CH groups, according to the diagram here given, in which R designates the above four different sidechains:—



The common feature, and one to the chemist of the older and conservative school most attractive, in all the work reviewed, is that it rests upon the basis of the old, classical valence-theory, a theory of which Staudinger has for years been a valiant defender.

Transparent Effects upon Natural Silk

R. Huenlich-Monats. f. Seide u. Kunst-Seide 39,194 (1934).—Alteration of the physical characteristics, tactile as well as optical, of such fibers as cotton, by the action of a series of various swelling agents, has been practised for a long time (mercerization by means of caustic liquor, for example). Sulfuric acid of different concentrations, and concentrated nitric acid also, are being used more and more today, to produce other characteristic alterations of the cotton fiber. Work to a certain extent is being carried out upon wool, along the same general lines.

Silk is also susceptible to such modifications in structure and optical properties, little resistant as silk is supposed to be, toward vigorously acting inorganic reagents. The crepeing process, as successfully carried out upon woolen weaves, by the action of caustic liquor in the presence of glycerol, can be extended to silk, with the same results. It is surprising that such is the case. The alteration consists in increase of the translucency, alteration of the luster, and an evening-out of the fiber, resulting in an impression of greater uniformity of fiber in the parts affected. There is also brought about an increase of stiffness of fiber, to an extent which is more or less under control, and an increase in the scroop; and perhaps most valuable and striking of all is an alteration of the affinity of the modified fiber toward certain groups of dyestuffs.

The earlier work carried out along this line involved considerable duration of action (comparatively speaking). As a result, the alteration in the consistency of the material was considerable; shrinking and crepeing was the usual result. The present aspect of the process involves short, or very short, duration of the action of the swelling agent upon the fiber. In this way, transparent effects are chiefly obtained. The conditions maintained depend essentially upon the concentration of the bath, the temperature, and, of course, the time-factor. Mild conditions bring about chiefly an equalization of the structure of the weave as a whole; more vigorous conditions increase the translucency; in the latter case, greater stiffness of the goods and alteration of luster are also brought about. Naturally, the conditions are so chosen that an alteration of the chemical structure of the fiber (degradation) is not brought about. Such a damaging of the fiber must of course be avoided; yet the desired alteration of the physical properties must be attained; so that one is working along a margin, so to speak. The conditions must also be such that no shrinking of the fabric takes place (no noticeable shrinking, at least), since otherwise the desired effect will not be produced.

Agents which have been employed as suitable are the alkali hydroxides, especially potassium and sodium hydroxides, mineral acids (except nitric acid)—sulfuric, phosphoric, hydrochloric acids, solutions of simple or complex salts, as zinc chloride, cupro- and nickel-oxide ammonia, alkaline cupro-glycerine solution, and sulfocyanides. The concentration of the agent may vary within the widest limits, according to the degree of alteration de-

sired. The higher concentrations, strangely enough, are involved in the use of the alkalies and acids. The temperature also varies according to circumstances; when the mineral acids are employed, with high concentration, naturally the temperature must be low, in order to restrain the tendency of the agent to break down the chemical structure of the fiber.

Mixtures of the various agents possible are also employed, and also successive treatment with more than one agent, with or without intermediate washing out of the preceding one; for example, the fabric may first be treated with mineral acid, then washed, and then treated with caustic. The fabric may be treated under tension or not, according to what effect is desired. According to the kind of silk, it is boiled off previously to a greater or less degree; and the customary bleaching may take place either before or after the swelling-treatment. Local vigorous treatment will of course produce design-effects; and the process may be carried out upon mixed weaves.

Eulan Treatment of Wool, Studies in the

Dr. Otto Mecheels—Mell. Textil-Ber. 14, 42 (1935).—"Eulan New" was brought out by the I. G. in November 1928, and has proved to be an anti-moth agent of the highest value—extremely permanent in its protective action upon wool, and stable toward dyeing processes. It is added directly to the acid dyebath, from which it begins to take upon the fiber at about 60° C. The wool shows no visible alteration, the dyebath apparently continues to react normally, and by correct working no complications ensue. Some experience has shown, however, that the process requires study, in order for one to be able to control results accurately; and the author has here given the results of his work upon the topic.

The study is reported in a brief, compressed (not condensed) manner, and covers the following points:—affinity of Eulan for the fiber, rate of absorption of dyestuff by the fiber, course of action during dyeing, qualitative analytical investigation (a-stripping of fiber by caustic soda, b-the ninhydrin method); quantitative investigation (colorimetric and volumetric methods), and physical investigations.

Some points established in particular are as follows: a bath temperature of 60° C. is the critical temperature for wool dyeing in the presence of Eulan. If the temperature is raised step by step, say from 40° to 80°, there is acute danger of the dyeing coming out unlevel and streaky. The Eulan then goes on upon the fiber too rapidly, and cannot exert its levelling effect upon the dyestuff in solution and going on simultaneously. The presence of Eulan in the bath does not require a larger quantity of dyestuff for a full dyeing, but rather actually increases the affinity between the fiber and the dyestuff, to a point beyond normal for merely dyestuff-in-bath. The degree of acidity of the bath, within reasonable limits, has no action upon the course of the dyeing. A certain degree of acidity, that recommended by the I.G., is, however, necessary to accomplish proper fixing of the Eulan upon the fiber. Eulan, in aqueous solution, gives with ferric chloride a dull blue precipitate, soluble with a blue color in ethyl and amyl acetates, insoluble in benzene, toluene, xylene, chloroform. The presence of Eulan upon the fiber, therefore, can be detected by destroying the fiber in conc. sulfuric acid, diluting, and testing as above, or by stripping the fiber with dilute caustic and testing the extract (acidifying with acetic acid before extracting with amyl acetate). Ninhydrine, or triketo-hydrindene, a reagent for albumens, peptones, polypeptides, and amino-acids in physiological chemistry (and used in medicine as a means of proving pregnancy with certainty in doubtful cases) also proved of some value in the author's work; of samples of wool treated or non-treated with Eulan, aqueous extracts of the former gave very weak color-tests for amino-acids, while the untreated fiber gave strong color-tests with the reagent. The test, however, is not as satisfactory as the ferric chloride test, since the acid added in making up the Eulan-dyestuff-bath forms a mineral-acid salt with the amino-group or -groups of the wool substance, while the ninhydrine test requires the free amino groups to be available. But, if the extract to be tested is treated with pyridine to remove the mineral acid, the aqueous extract of the wool substance does give a satisfactory (blue) test with ninhydrin.

The two tests mentioned give a decisive distinction between wool treated, and wool not treated, with Eulan.

In conclusion, the dyeing properties of Eulan (and it must be recalled that the product, applied in acid bath, does possess a strong, definite affinity for wool) allow of the maintenance of normal conditions in wool dyeing. To assure level dyeings, the temperature of 60° C. must be regarded as critical. The valuable properties of the wool, as its luster and softness, are in no case harmed, but rather, in frequent cases, are improved. Eulan-treated wool seems a little more resistant to chemical action than does untreated wool. The ninhydrin test gives some insight into the chemical process of formation of the Eulan-wool compound, and possibly affords an explanation of the protective action of Eulan toward attack by larvae.

Pipe Fittings and the Acetylene Torch in the Dyeing and Finishing Plant

JOHN E. HYLER

AMONG the many possibilities opened up in shop installation and maintenance work by the acetylene torch, one of the most interesting is its application to various pipe lines. Some have gone to the use of special fittings which are especially designed for the making up of pipe lines by welding. Such fittings are a worthy item to be kept in storage. An interesting proposition

in this connection is the modern hole saw, which can be mounted in any electric drill, and used for sawing a hole of any required diameter in a large pipe or header to allow the attaching of a smaller pipe by welding. Hole saws are growing in popularity for this and for other forms of work, and are less expensive to use than they were some years ago. Some now use a type of hole saw having a removable saw blade that can be thrown away when worn, and another substituted. In this manner, the major portion of the hole sawing tool is salvaged, and will last almost indefinitely.

Another clever idea with reference to pipe fittings is found in use by some, which is really a brazing proposition, rather than one of welding. The fittings, having an internal annular channel filled with a brazing alloy, slip together quite readily, and when the acetylene torch is applied, the heat melts the alloy and causes it to flow into and through the joint, joining pipe and fitting tightly. There is usually a reserve of the brazing alloy left in the channel, so that if a leak develops under test, the repair is simply the application of more heat from the torch, to make it perfectly tight.

NEW PRODUCTS—TRADE NOTES

• COLORED ASBESTOS FABRICS

Vari-colored asbestos fabrics have recently been introduced in England by British manufacturers, and being fireproof, are recommended by them for rugs, table covers, kitchen aprons and the like, according to reports received in the Commerce Department's Chemical Division.

Encouraged by improved technique in the dyeing of asbestos fabrics and the consequent availability of numerous colors, English manufacturers are now attempting to direct public attention to the variety of uses to which such materials can be put.

Items made from colored asbestos fabrics and displayed at a recent exhibition in London included aprons, gloves, window curtains, panelling, wall covering, rugs, table covers, and a number of other everyday products, according to the report.

Some of the articles and materials displayed are not yet on sale generally, but are expected to be ready for distribution within a relatively short time.

Further developments and refinements in texture and in dyeing are anticipated, the report states.

• CORONATION COLORS

In honor of the Coronation of King Edward VIII, the Textile Color Card Association will issue a collection of colors which it will dedicate to the King.

This collection, commented Margaret Hayden Rorke, managing director of the Association, will have as its theme the colors which are symbolic of the pomp, pageantry and grandeur of this great forthcoming event. Mrs. Rorke, who recently returned from an extended European trip, made extensive research while in England on the historical coronation ceremonies and the robes and the colors identified with them. Mrs. Rorke brought back a great deal of unique and authentic data which she will use as a background for this special color group.

These coronation-theme colors will first be issued in connection with the Association's 1937 Spring Season Confidential Advance Card.

• CALCO RELEASES

Calco Chemical Co. announces release of the following new products:

Calcoloid Yellow 5GD Double—the latest addition to the Calco line of dispersable vat powders. This standard, like others in the group, may be dyed on yarn or piece goods by the various methods usually employed.

Calcomine Blue RRW—offered as similar in general properties to *Calcomine Blue RW*. It is of particular interest, however, because it is said to possess greater drawing power on tin-weighted silk when applied in heavy percentages. This permits the more economical production of heavy Navy shades. This property is also said to carry through to dyeings made on rayon.

• AVIROL TO AVITEX

A change in the name of Brilliant Avirol to Avitex is announced by the Organic Chemicals Department of the du Pont Company. The change is in the name only, the product being the same line of finishing agents derived from higher fatty alcohols. Avitex has been adopted to distinguish the du Pont finishing agents from other types under the avirol name.

The new names corresponding to the old are: Avitex SF, formerly Brilliant Avirol L-142; Avitex AD, formerly Brilliant Avirol L-144; Avitex W, formerly Brilliant Avirol L-168; Avitex C, formerly Brilliant Avirol L-200.

• CYANAMID BOOKLETS

American Cyanamid and Chemical Corp. announces publication of two new booklets one of which is entitled *Waxes* and the other *Natural Resins*. Among the waxes discussed in the first mentioned booklet are the following: beeswax, candelilla, carnauba, ceresin, Chinese wax, Japan wax, montan, ozokerite and spermaceti. Also included in this booklet are tables entitled: Wax Type Acids and Higher Wax Type Alcohols, Origin and Use of Waxes, Solubility of Waxes and Properties of Waxes. In a similar way natural resins are discussed in the second booklet. Both of these booklets contain much valuable information and copies are available upon request.

• GENERAL RELEASE

General Dyestuff Corp. announces release of the following new sample card:

Dyeings Fast to Light on Woolen Yarn—a sample card showing numerous dyed shades on woolen yarn, produced with acid dyestuffs which were especially selected for their level dyeing and good fastness to light. Formulae are given to produce the same shades, as far as possible, in better fastness to washing, perspiration, water and salt water with Supramine, Supranol, Palatine Fast and Monochrome colors. Card I. G. 996.

• JOINS KENNEY—HERSTEIN

Robert Schmeidler, M.A., F.A.I.C., has joined the staff of Kenney-Herstein, Inc., Consulting Chemists, as an associate. Mr. Schmeidler had been for the past eleven years connected with the United Piece Dye Works as chemist in charge of the production and utilization of textile chemicals. In his new connection Mr. Schmeidler will function as a consultant on both the production and application of chemical materials in the textile field and on textile processes.

• 37th ANNUAL CONVENTION

The 37th annual convention of the International Acetylene Association is to be held at the Hotel Jefferson, St. Louis, Missouri, on November 18th, 19th and 20th. Papers will be presented on various subjects of interest to industries which do any welding or cutting.

• MONEL PAMPHLETS

The International Nickel Co. has published two pamphlets concerned with the use of Monel metal in dyeing plants. One is entitled *Monel Metal at the Bertram Goldberg Plant* and the other *Monel Metal at Maupai Dyeing Company*. Both booklets describe the particular uses of the metal in the individual plants and the benefits resulting therefrom. Copies are available upon request.

• NUSOPE 48-B

Nuodex Products, Inc., announces the development of a new product to be known as "Nusope 48-B" which represents a liquid said to possess the unusual property of being soluble in either mineral spirits or water. It is also claimed that this product is a free flowing liquid even though it contains 85% of solids; that it is completely neutral and will hydrolize in water only to ⅛ the extent of sodium stearate; that it seems to be an excellent frothing and emulsifying agent as well; that it shows excellent detergent action and combines with this feature the ability to form stable emulsions of water and oils. Samples and further data are available by writing the above-named company at 312 Division St., Elizabeth, N. J.

• RAYON BOOKLET

Ciba Company, Inc., announces publication of a new booklet, authored by Edward W. Pierce, technician of the company, entitled *Rayon and Its Dyeing Processes*. The booklet constitutes a brief summary of lectures delivered before the Canadian Association of Textile Chemists and Colourists at Hamilton, Ont., on August 22, 1935. Included in the subject matter the following headings are to be noted: viscose yarn manufacture, nitro-cellulose yarn, cuprammonium yarn processes, cellulose acetate processes, skein drying, delustering methods, dyeing with direct dyes, color variations due to yarn twist, dyeing acetate yarns, vat dyes on rayon, use of naphthols, dyeing woven and knitted rayon goods, rayon piece dyeing machine, dyeing acetate rayon fabrics and dyeing acetate piece goods. Copies of this booklet are available upon request.

• ADVANCE OF CHEMICAL RESEARCH

Intensive research through the depression years has brought the chemical industry to a higher peak of employment and achievement than that of the so-called boom year of 1929, said Dr. Edward Ray Weidlein, director of the Mellon Institute and President-Elect of the American Chemical Society, in a nation-wide radio broadcast, Wednesday, September 9.

Dr. Weidlein spoke over the Columbia network from the William Penn Hotel in Pittsburgh, where 2,500 members of the society, world's largest organization of scientists, are attending its 92nd national meeting. His talk was a part of the "Cavalcade of America" weekly broadcast, dedicated to the achievements of research chemistry and sponsored by Du Pont.

"American chemists," Dr. Weidlein said, "through their constructive methods of creating new industries, new products and new uses for old products during particularly the last ten years have demonstrated the value of sound training and clear thinking. That is the reason why research proceeded through the depression at an accelerated rate. Right now employment in the chemical industry is nearly ten per cent greater than in the peak year, 1929. Whether significant or not, it is a fact that in 1936 our chemical industry employs more men, produces more goods, and sells more goods at a lower price than in the so-called boom year of 1929. We need more industries like the chemical industry and more encouragement and support for industrial leaders."

Emphasizing the fact that chemistry's work in the world has only begun, he pointed out the important contributions of chemistry to the national peace of mind, in its ability to supply substances needed for impoverished soils and necessary to replace impoverished natural resources and in its capacity to create new synthetic products and to found new industries.

• COLUMBIA EVENING COURSES

Six evening courses in the manufacture of textiles will be given in Columbia University Extension beginning September 24. The studies, which will deal with woven and printed fabric design, the manufacture and converting of silk goods, woolen and worsted manufacture, spinning and weaving of cotton, rayon and other synthetic yarns and piece goods, are designed particularly for those in the trade. Registration began Saturday, September 19.

John J. Reutlinger will direct elementary and advanced studies in the manufacture and converting of silk goods. He will describe many of the technical processes as well as marketing conditions in Japan and the United States. Prospective trips to nearby plants will be scheduled.

Spinning and weaving of cotton, rayon, and other synthetic yarns and piece goods will be analysed in two courses directed by Herbert R. Mauersberger, B.T.E. A historic and statistical survey of the cotton industry will precede the technical features of one course, while the four types of synthetic yarns will be described in the other.

The study of woven and printed fabric design, directed by William H. Arlt, will embrace the planning and creating of practical designs for weaving and printing on silk, cotton, and rayon for dress, drapery, and decorative fabrics. Various methods of engraving for reproducing designs will be described.

Werner von Bergen will conduct the study of woolen and worsted manufacture. The growth, kinds and marketing of all types of wools and related fibers will be dealt with. Manufacturing processes, yarn calculations, and the French and Bradford systems of carding, combing, drawing and spinning for worsted yarns will be features of the study.

• TEXTILE WASTE TREATMENT

The Textile Foundation, Inc., now has made available a report on *Textile Waste Treatment and Recovery*.

The material presented in this 118 page booklet was collected during a thorough survey of the field of liquid textile waste disposal. The survey included an extended search of domestic and foreign literature and study of numerous unpublished research reports, consultation with the leading chemists and engineers experienced in the field, and examination of many plants now treating textile wastes. All up to date information concerning textile waste disposal is summarized in the report submitted to the Textile Foundation.

The report, although technical in nature, is written in layman's language. It should be useful to manufacturer, chemist, engineer and student interested in problems cerning both textile manufacturing and of waste disposal. Particular care has been taken to provide basic information consanitary engineering. This has been done in order that the report will be useful to both the engineering group and the textile group who cooperate in solving pollution problems.

Among the subjects dealt with in the report are: stream pollution and requirements for purified effluents; textile processes and the nature of the wastes produced; reduction of liquid wastes within the mill and the recovery of by-products; the methods used for treating textile wastes and the application of these methods for the treatment of certain specific wastes; the treatment of textile wastes in combination with municipal sewage; descriptions and diagrams of plants treating straight industrial wastes and wastes in combination with sewage; and finally the need for research in the field of textile waste disposal, with suggested prob-

lems. For the use of those who wish to go into more detail concerning certain phases of the problem, a classified bibliography of 340 references is included.

A number of copies are available for complimentary distribution to those especially interested in problems of textile waste disposal. Requests should be addressed to the Textile Foundation, Commerce Building, Washington, D. C.

The report was prepared by John C. Geyer and William A. Perry with the cooperation of the University of North Carolina, and in counsel with Dr. H. G. Baity, Dean of Engineering, and the Advisory Committee on Textile Waste Treatment. This Committee consists of: Prof. C. R. Hoover, Prof. of Chemistry, Wesleyan University, Technical Adviser for the Connecticut State Water Commission; Dr. Willem Rudolfs, Chief, Division of Water & Sewage Research, New Jersey Agricultural Experimental Station; Professor T. R. Camp, Associate Professor of Sanitary Engineering, Massachusetts Institute of Technology; Mr. H. W. Streeter, Sanitary Engineer, U. S. Public Health Service; Mr. Hill Hunger, General Manager of Cone Mills; Professor A. H. Grimshaw, Professor of Textile Chemistry & Dyeing, Textile School, North Carolina State College; Dr. A. M. White, Professor of Chemical Engineering, University of North Carolina and Dr. F. K. Cameron, Professor of Chemistry, University of North Carolina.

• SEPTEMBER TEXTILE RESEARCH

"Casein wool will probably have a field of application in fabrics in which it is incorporated with wool up to about 60-60%," is the opinion expressed by H. C. Borghetty, chief chemist, The Aspinook Co., in a communication published in *Textile Research* for September. Based upon his analysis of fabrics made in part of this "Lanital" he emphasizes the possibility of casein wool becoming popular as a new fibre, or as a substitute for a portion of the natural wood in woolen and worsted fabrics.

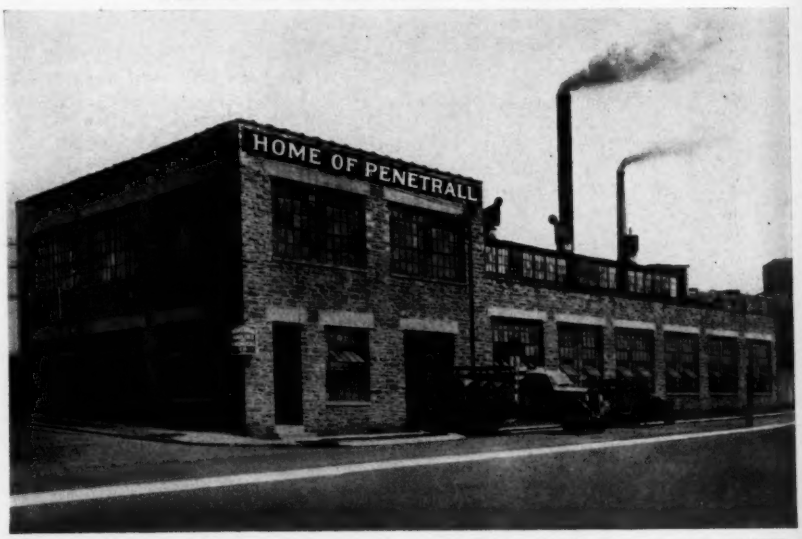
That Japanese textile manufacturers do not intend to rely entirely upon cheap labor, export bounties and other advantages for an increasing export trade is proved by an article in the September number of Textile Research describing the new Textile Institute of Japan (Sen-i Kwagaku Kenkiusho) recently organized for basic research on textile fibres, principally cotton. It is partially financed by the government, is operated in connection with Osaka University, and has an able staff of chemists and physicists. Previous issues of this magazine have told of the elaborate lab-textile research in Great Britain, India and the U. S. S. R. As yet the U. S. A. has nothing of a comparable nature. The Textile Foundation holds and administers a fund for textile research, and the U. S. Institute for Textile Research promotes scientific and economic research, and utilizes existing institutional laboratories and staffs for its co-operatively financed studies.

Other features of the September number of Textile Research, in addition to its regular review of textile research throughout the world, include a review by Erwin O. Kruegel, a Textile Foundation Follow, of progress made toward adoption of "Wool Top Standards," in which he presents in tabular form the fineness measure of the various grades of German tops in average microns, and the approximate American tops corresponding to these grades; also, by Bryce Prindle, a Textile Foundation Fellow, illustrated description of a "Method for the General Historical Examination of Normal and Mildewed Cotton Fibres."

• INDUSTRIAL ANILINE FACILITIES

The building and storage space of the Industrial Aniline & Chemical Co., consisting of 36,000 square feet, is located in Germantown, Philadelphia, in the heart of the textile area, being situated on the main thoroughfare to all points. The building is of stone, fire-proof construction with plenty of natural light and ventilation and modern in every detail. The laboratory is under the supervision of a practical chemist with years of dyehouse and textile experience. The services of this laboratory are available at all times. Facilities are available for prompt shipment to all points by railroad, motor truck, express, etc. Among the products manufactured by this are included "Penetrall," a penetrating and levelling agent, softeners, sulfonated oils, dye house assistants, general textile finishes, warp, skein and fabric sizes (both regular and the new permanent "New Process" rayon size), water repellants and flameproofing materials.

Plant of the Industrial Aniline & Chemical Co.



CLASSIFIED

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i.e., help wanted, machinery or supplies for sale—the rate is $5.00 per column inch or less per insertion.

POSITION WANTED: Young man, B.S. in Chemistry will work at nominal salary to get experience in field. Would prefer position in Metropolitan area. Write Box No. 925, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

WANTED: Old established manufacturer of textile oils and chemicals wants a salesman for the Southern territory. An excellent opportunity is open to the right man. Only those with selling experience in Southern states and knowledge of practical application of products need apply. Write Box No. 926, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

POSITION WANTED: Print Works Colorist with wide experience on all classes of colors desires to make connections with progressive firms. Write Box No. 927, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.